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JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

AMERICAN REPERTORY

OF

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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VOL. 33

THIRD SERIES.
VOL. III.

PHILADELPHIA.
PUBLISHED BY THE FRANKLIN INSTITUTE, AT THEIR HALL.

1842

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MECHANICS' REGISTER.

JANUARY, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. Klein, *Civil Engineer.*

Within the last few years, internal improvements, principally railroads, have made very great progress upon the continent of Europe. The example given first by Great Britain, and later, on a much larger scale, by the United States of North America, could not fail to attract the attention of other people and governments. The important influence of facilitated internal communications upon the prosperity of a country could no longer be doubted; all prejudices against their introduction were gradually vanquished, and the spirit of enterprize and speculation became awakened. We now see extensive lines of railways already completed, and others in progress, in different parts of the continent of Europe, and at no distant period we may expect to see connected *by* them all the capitals and other important cities of the numerous states and provinces, in which this large territory is divided.

Although the United States are already provided with a system of railroads, the extent of which far exceeds that of all railroads executed in all the other parts of the globe, a notice of the works undertaken and accomplished in Europe cannot be without interest to the readers of this journal, and principally to the engineer, who may find in the history of every railroad, in the description of its locality and construction, and of the difficulties overcome, something new and in-

structive. In the following notes, for which the data were carefully collected on the spot, and may be relied on as correct, it is intended to give a short description of the works of internal improvement executed, or undertaken and in progress, in different states of the continent, in the order in which they were examined.

Having during a long stay become possessed of detailed information concerning all the railroads now in operation and in progress in Austria, I am enabled to commence the present communication with a full description of the internal improvements in that empire, though my notes may not be as complete respecting the other European States.

LETTER I.

Vienna, 1st of September, 1841.

Internal Improvements of the Austrian Empire.

Geographical notice—Navigation—Steam navigation upon the Adriatic and Mediterranean, upon the Danube—Canals in Italy and Hungary; the Vienna and Newstadt Canal—Turnpike roads—Lintz and Gmunden—Prague and Pilsen railroads—Emperor Ferdinand's northern road—Vienna and Raab railroad—First Hungarian railroad from Presburg to Tyrnau—Milan and Montza—Milan and Venice railroads—Railroads projected; Bohemian coal road, Prague and Dresden, Vienna and Trieste railroads, central railroad of Hungary, Bochnia and Lemberg railroad.—Extent of railroads completed, in progress, and projected, in Austria.

The Austrian empire occupies the central part of the European continent, and covers the one thirteenth part of its surface. In regard to area Austria ranks the third amongst the European States, being inferior only to Russia and the United Kingdoms of Sweden and Norway; in regard to population it ranks the second, as it is surpassed only by the Russian empire. Austria extends from 42° 9′ to 51° 2′ north latitude, and from 26° 14′ to 44° 45′ east longitude, (the meridian over the island of Ferro taken as the first,) or over 8° 53′ from south to north, and 18° 21′ from west to east. It is bounded by twelve different sovereign states, of which, however, some are very small. The longest boundary line is towards Turkey, viz. 1,550 miles, while the length of boundary towards all the surrounding states is 4,166 miles. To this must be added the length of sea coast on the Adriatic, which (the islands excepted,) measures 1,248 miles, making the total length of boundary, or the circumference of the empire equal to 5,414 miles. Considerable as this length of the sea coast may appear, its advantages in regard to commerce are much diminished by the peculiar situation, form, and distance from the main body of the Austrian empire.

The monarchy of Austria is composed of sixteen large provinces, inhabited by nations different in origin and language, viz: of eight kingdoms, one Archduchy, (Austria, of which the empire bears the

name,) four Duchies, one grand Principality, one Margraviate, and one Principality—county. The following table contains the area and population of the different provinces.

Name of Province.	Area in square miles.	Population in 1837.	Inhabitants to the square mile.
Archduchy of Austria,	15,725	2,168,694	138
Duchy of Styria,	9,055	935,576	103
Kingdom of Illyria,	11,430	1,195,874	105
Kingdom of Bohemia,	21,155	4,001,925	189
Margraviate of Moravia with Silesia,	11,050	2,074,246	188
Kingdom of Galicia,	35,510	4,518,360	127
Kingdom of Hungary and vicinal provinces,	92,990	11,138,942	120
Grand Principality of Transylvania,	24,705	2,170,392	88
Military boundary districts,	13,550	995,861	73
Kingdom of Lombardy, Venice,	18,505	4,534,197	245
Kingdom of Dalmatia,	5,210	373,479	72
Principality, county of Tyrol.	11,475	814,892	71
	270,360	34,922,438	129

This population did not include the army; with the latter it was 35,398,438. At present (1841,) the population of the whole Austrian monarchy is computed at 36,500,000 souls, equal to 135 per square mile. Only a part of the Austrian empire belongs to Germany; the area of the Austrian German provinces is 79,880 square miles, and their population, 11,613,280. The standing army of Austria consists in 324,000 soldiers.

By the Adriatic the Austrian empire is brought in contact with the sea, and in direct communication with foreign ports. Trieste, Venice, and Fiume, are the three principal sea ports of Austria, from which an active trade is carried on, not only along the coast of the Adriatic, but also with the principal ports of Italy, France, and Spain, Greece, Asia minor, and Egypt. *Trieste,* the most important port of the three, exports principally the products of the German provinces of Austria; *Venice,* once the queen of the seas, the centre port for the Indian trade, before the passage round the Cape of Good Hope was discovered, is now of minor importance, although it has been a free port several years; it exports the products of the Italian provinces. *Fiume* commands only a small trade; it is the principal port on the Adriatic, for the Hungarian provinces, with which, however, it is connected only by very bad roads. There are at present in Austria

516 vessels for distant voyages, with a tonnage of	105,400	tons.
1320 large coasters, " "	48,300	"
1345 small " or rather boats, "	10,200	"
Total tonnage,	163,900	"

Only from three to six Austrian vessels go annually from the Aus-

trian sea ports to London; about as many to the different ports of the North Sea and the Baltic; from nine to twelve make voyages to Brazil, and from fifteen to seventeen to the United States of North America. The greatest part of the foreign trade with Austria continues to be carried on by foreign vessels.

During the latter years a great impulse was given to the trade of the Mediterranean by the introduction of steam navigation, in which Austria did not remain behind. Regular trips are now made between Trieste and Venice, Trieste and Constantinople, Trieste and Ancona, &c., as also between Constantinople and the ports of Syria and Egypt. The steam navigation company of the Austrian Lloyd at Trieste, now own eleven steamboats, and the following have been their operations in 1840.

Voyages. 1840.	Number of trips.	Passengers number.	Freight, cwt.*	Packages, pieces.	Specie and precious articles, amount.	Letters, number.	Income. Dollars.
Between Trieste and Constantinople,	24	9,661	38,359	7,206	$1,764,763	10,062	219,274
" Constant., Valo, Salonica, Alexandria, and Syria,	22	6,465	2,416	185	110,254	2,162	
" Trieste and Venice,	155	15,053	9,199	10,892	4,038,942	5,786	62,276
" Trieste and ports of Dalmatia,	20	2,569	2,047	3,168	254,452	1,555	9,488
" Trieste, Ancona, and other ports of Italy.	64	5,138	1,364	230	106,913	559	12,805
	285	38,886	53,385	21,681	6,275,324	35,087	313,843
In 1839	245	27,930	40,366	15,561	5,481,563	23,251	

* One Austrian cwt. = 100 Austrian lbs. = 123½ English lbs.

The expenditure of the company for the year 1840 has been:

For loading and unloading, port and consul duties,	$ 17,234
Salaries, board of crew, repairs, and sundry disbursements, - - - - -	107,803
Fuel: coal and wood, - - -	85,764
Administration, - - -	54,398
Total,	$ 265,199
Net profit, - -	48,644
	$ 313,843

Austria is traversed by many navigable rivers, but only few of them offer great facilities for internal communication. The principal river

of the Austrian empire, the mighty Danube, has a course of more than 2,000 miles of length, of which 850 miles are in Austria; it forms the natural highway to the Black Sea and the Orient. Until it reaches the plains of Hungary the current of the Danube is very rapid, having through a great part of Austria an average speed of five to six feet per second, or about four miles per hour. The width of the river is unequal; near Vienna, for instance, it is 18,000 feet, or 3.4 miles; at Belgrade, only 3,160 feet; at the "iron Port," 500 feet, and at Orsova, where the Danube leaves the Austrian territory, the width is 2,053 feet. The swiftness and changeableness of current, the shallowness in many places, winding course, cliffs, &c., offer great obstacles to navigation, especially up stream. Nevertheless, thousands of boats come down and up the river to Vienna, with provisions, and all kinds of agricultural and mineral products.

The importance of the introduction of steam navigation upon the Danube was felt at an early period, and as early as in 1819 attempts were made to that effect. Want of experience and of confidence, however, for a time, retarded their success; in 1830, a chartered company took the matter in their hands, and in the following year (1831,) the performances of the first boat, "Francis I," proved the practicability of steam navigation upon the Danube. In 1832 two steamboats made regular trips between Raab, Pest, and Semlin, in Hungary; in 1834 the "Argo" went the first over the rapids at the "Iron Port," and arrived safely at Galatz. Subsequently steam navigation was extended up the Danube, from Vienna to Lintz, and through Bavaria to Ratisbon.

The steam navigation company's boats now make regular passages throughout the navigable season between Lintz, Vienna, Pest, Semlin, Galatz, Varna, Constantinople, Trebisond, Salonica, and Smyrna. A passage from Vienna to Constantinople requires twelve days, and costs, in the first cabin, 62½ dollars, in the second cabin, 42½ dollars, and on deck, 28 dollars, exclusive of board.

In 1840 the company had in operation ten river boats and seven sea boats; at the same time they were building five new boats for 1841, making the total number twenty-two. The number of passengers carried by all the steamboats, in the year 1840, was 125,293; the quantity of freight, = 20,482 tons; the income from all sources has been:

From the ten river boats, - - - -	$ 175,135
" seven sea boats, - - - -	123,953
" discounts, &c., - - - -	4,469
Total,	$ 303,557

Amount brought forward, - - -	303,557
The current expenses during the year amounted to	154,145
Leaving as net profit, - - -	$ 149,412

The capital stock of the company consists in 7,560 shares at 250 dollars, or in 1,890,000 dollars; the net profit in 1840 was therefore 7.9 per cent. on the capital invested.

How much the business done by the steamboats is on the increase, will be seen from the following numbers, showing the traffic from 1837 to 1840, inclusively:

	Year 1837	1838	1839	1840.
Passengers,	47,436	74,584	105,926	125,293
Tons of freight,	4,111	17,812	19,388	20,482

The steamboats used upon the Danube and the Black Sea, are all built on the English model; two of them, the "Sophia" and "Stephan," are of iron. The "Sophia" has two low pressure engines of sixty horses power each, and goes only three feet deep when loaded. She is used exclusively upon the upper Danube, between Vienna and Lintz, where navigation is most difficult. A trip down from Lintz to Vienna, a distance of 144 miles, is performed in nine hours, or at the rate of sixteen miles per hour, while a trip up, from Vienna to Lintz, requires not less than thirty-two to thirty-six hours, and sometimes more. The fuel used is coal, from the vicinity of Pilsen, in Bohemia, and costs, delivered at Lintz, eight dollars and ten cents per ton. Another company, chartered in the kingdoms of Bavaria and Wurtemberg, run their boats between Lintz and Ratisbon, in connection with those in Austria.

A new impulse will be given to the steam navigation of the Danube by the different railroads now in progress in the vicinity of this river, but still more by the "Maine and Danube Canal," in Bavaria, which approaches its completion. This canal, of which I shall take occasion to speak in my subsequent letters, is 108 miles in length, and connects the Danube, near Ratisbon, with the Maine at Bamberg; the latter river is to be improved for steam navigation to its mouth at Mentz, whence numerous steamboats are running upon the Rhine to Rotterdam and the German Ocean. On the completion of the canal, an uninterrupted connection by water will exist between the North Sea, or German Ocean, and the Black Sea, certainly one of the most magnificent lines of internal communications in the world.

Besides the steamboats upon the Danube and the Adriatic, there are only a few boats upon some of the minor rivers and lakes in Austria. A small boat has lately been started upon the Moldau at Prague, to run between that city and Dresden; she draws only sixteen inches water, but can, nevertheless, come up to Prague only at

high water, the Moldau being too shallow through a great part of the year. A great deal remains to be done in Austria in the improvement of rivers and the extension of navigation upon them. Steam navigation may, in fact, be regarded here as in its infancy, if compared with the high degree of perfection it has attained in the United States, where it originated.

Canals.—There are comparatively few canals in the Austrian empire, and most of them are in the kingdom of Lombardy—Venice, (Italy.) The following are the principal ones: the "Naviglio Grande," which connects the Ticino river and the Lago maggiore with Milan, length twenty-seven miles; the "Martezana" Canal connects the Adda, and thereby the Como lake, with Milan, and is twenty-six miles in length. The "Naviglio nuovo" extends from the Naviglio grande, at Milan, to the Ticino, at Pavia, whence by means of the Po river a connexion is effected with the Adriatic; length, nineteen miles. Many other canals of different lengths traverse the country, but serve, for the greatest part, only for irrigation.

In Hungary we have the "Francis Canal," which unites the Danube with the Theiss; it was executed between the years 1793 and 1802, by a company of stockholders, at a cost of 1,500,000 dollars; length, sixty-eight miles. The "Bega Canal," of seventy-five miles in length, serves to improve the navigation of the Bega.

There is only one canal in the other Austrian provinces, which serves for the transportation of goods, viz: the "Newstadt Canal," which extends from Vienna through Lower Austria to the frontier of Hungary. This canal was undertaken by a company in 1797, with the object of connecting Vienna with Trieste; afterwards it was resolved to extend it only to the coal mines near Oedenburg, in Hungary. In 1800, the government took charge of the works, and finished the canal to the frontier of Hungary, in a length of forty-five miles, in 1803. The extension to the coal mines at Oedenburg, (fourteen miles,) was not acceded to by the Hungarians.

The total ascent from Vienna to the other terminus of the line is 328 feet, the number of locks, fifty. The canal is thirty feet wide on the surface of the water, and four feet deep. The locks are eighty-seven feet in length, and built partly of cut stones, partly of bricks, the latter are now re-built with stones. The width of the locks is only eight feet. The boats used upon this canal are eighty feet long, and only six feet wide; they draw three feet water with their maximum load of twenty-five tons.

Since 1822, the canal is leased by the government; the present contractor pays an annual rent of 6,540 dollars, and has to keep the canal, boats, &c., in perfect order. The principal articles transported

upon this canal are bricks, wood, coal, and some merchandize; nearly all the freight is in coming down to Vienna, and the boats return back empty. The contractor of the canal is bound to forward all articles at a fixed tariff, from the 1st of April to the 30th of October, but generally the navigation of the canal is open during eight months in the year.

The contractor furnishes the boats, men, and horses, and charges to the owner of the goods so much per *load,* or per cwt. For a load of fire wood, (about eleven cords weighing eighteen tons,) the charge is for the whole distance, (forty-five miles,) fifteen dollars, or at the rate of 1.85 cents per ton per mile. The charge for coal is ninety-three cents per ton, (2,000 lbs.) for the whole distance, or 2.07 cents per ton per mile; for merchandize from Neustadt to Vienna, (thirty-eight miles,) one dollar and twenty cents, equal to 3.16 cents per ton per mile. Up to Neustadt the charge is only eleven dollars per load, or eighty cents per ton = 2.11 cents per ton per mile—6,000 bricks are reckoned a load.

There are carried annually, over the canal, about

10,000,000 of bricks, weighing	47,000 tons, (of 2,000 lbs.)
30,000 cords of fire wood,	55,000 "
Stone coal, - - -	2,500 "
Merchandize, - -	800 "
Total,	105,300 tons.

For a trip from Vienna to Neustadt and back, three days are required; the boat is drawn by one horse, and served by three men; the pilot, whose daily wages are nineteen cents; the bowsman, who receives eighteen cents, and the driver, who gets twenty cents per day. The boatmen furnish the horse, and receive for it fifteen cents per day, besides food. At present the number of boats used upon the canal is seventy; the number of arrivals at Vienna during the year 1840 was 6,339. The cost of a new canal boat is 200 dollars.

The contractor of the canal has not only to keep the canal, buildings, &c., in perfect repair, but also to re-build the old brick locks. There are thirty-four lock tenders on the line, each of whom receives twenty cents per day; the maintenance of the whole canal costs, annually, near 15,000 dollars.

There are many remarkable structures on the Neustadt Canal which deserve to be noticed, such as the fifty-eight stone bridges by which the communication between the two banks is entertained; the fifty locks, of which eight are within the city of Vienna, where, on a length of nearly two miles, the banks of the canal are protected by

perpendicular stone walls; the large basin at the terminus in Vienna, where the boats are unloaded; several large aqueducts, of which those near Baden and Neustadt are the most prominent, &c., &c.

Turnpike Roads.—Extensive is the system of turnpike roads, with which the Austrian empire is covered. Nearly all the provinces are traversed in many directions by well constructed and well maintained roads, built, for the greatest part, at the expense, and under the direction of the government. Leading from city to city, they connect all the different parts of the monarchy with each other, and with the adjoining countries, not impeded even by those numerous giant mountains, which seem to put an eternal barrier to all communications between the countries separated by them. We mention in the following only the principal lines. Regarding Vienna as the centre of the empire, the great commercial roads are:

1. That from Vienna to the Adriatic in several branches, passing the Semmering on an elevation of 3,920 feet, and the Loibl mountain on an elevation of 4,360 feet. Distance from Vienna to Trieste, 336 miles.

2. The road from Vienna to Lintz, the capital of Upper Austria, and from there to Bavaria in one, and to Innspruck, Verona, and Mantua, in another direction, passes over the Alps and surmounts the Brenner, at an elevation of 4,646 feet. Distance from Vienna to Mantua, 490 miles.

3. From Vienna to Prague there are two roads; distance, 188 miles. From Prague numerous turnpikes lead to different parts of Germany.

4. A turnpike leads from Vienna over Presburg, Raab, &c., to Buda and Pest, from there to Hermanstadt and the Walachia, and over Peterwaradin to Semlin and Belgrade, as also over Debretzin to Clausenburg. Distance from Vienna to Belgrade, (Turkey,) 490 miles; to Cronstadt, (Transylvania,) 627 miles.

5. The road from Vienna to Lemberg, the capital of Galicia, and from there to Brody, on the frontier of Russia. Length, 590 miles.

6. From Vienna over Oedenburg, Agram to Carlstadt, and continued to Fiume and Zara, in Dalmatia. Distance to Zara, 400 miles.

In regard to the difficulties overcome in their construction, the following deserve particularly to be mentioned, the road from Carlstadt to Fiume, constructed in 1809, which surmounts a summit of 3,120 feet in height, and is nevertheless used by the heaviest wagons; the military road over the Stilfserjoch mountain, built from 1820 to 1825, at an expense of 1,450,000 dollars; it extends from Bormia to Tyrol, where it connects with the road to Innspruck, and is the highest known pas-

sage over the Alps, as the summit of the Stilfserjoch is 9,536 feet high, and therefore elevated above the snow region.

In the same manner as the great commercial roads are connecting the metropolis of the empire with the capitals of the provinces, the provincial roads connect these latter with other less important towns, and by these lateral roads new extensive connexions are again formed. All these roads were constructed, and are maintained by the government, which expends annually, for this purpose, from two to three millions of dollars. The cost of maintenance is partly sustained from the tolls collected.

Constructed in a less expensive and durable manner, but still more extensive are those roads which are built and maintained by the communities; they form innumerable branches to the commercial and provincial roads, and extend the facilities of intercourse to the very door of the agriculturist. Most of these roads are to be found in the kingdom of Lombardy—Venice; while in Hungary, on the contrary, very little has been done yet in this respect. According to statistical data the following is the extent of roads in the different provinces of Austria, with the exception of Hungary and the adjoining provinces.

Name of province.	Turnpike roads built and maintained by government.	Other roads.	Total length of roads.
	Miles.	Miles.	Miles.
Lombardy—Venice,	2,580	18,390	20,970
Illyria,	870	2,300	3,170
Bohemia,	2,000	5,220	7,220
Austria,	1,175	3,920	5,095
Tyrol,	790	1,460	2,250
Styria,	475	2,155	2,630
Monravia and Silesia,	565	2,800	3,365
Galicia,	1,735	520	2,255
Dalmatia.	170	390	560
	10,360	37,155	47,515

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Force of the Wind and Sea, observed at the Delaware Breakwater in 1830 *and* 1831, *with some suggestions concerning the transverse sections of Breakwaters. By* ELLWOOD MORRIS, *Civil Engineer.*

That the force of the sea and wind often operates with tremendous energy against objects which resist their action, is a fact well known; to measure this force with precision is from the nature of things impossible, and hence it is only by a close attention to the observed

effect produced by the waves of storms, upon opposing objects, that the engineer is enabled to form a proper idea of the energies of an agitated sea, when roused by gales to the assault of works raised for the protection of harbours.

To form a well sheltered harbour upon a site fairly exposed to the ocean, is one of the most difficult problems which can be proposed for solution by the engineer, for such is the difficulty of forming a stable barrier against the sea, that notwithstanding all that has been done in erecting sea-works under the direction of the ablest minds, we can at this day scarcely, if at all, point to an artificial harbour in a dangerous roadstead, which has realized the expectations of its projectors.

To appreciate, properly, the active forces which we are to countervail, is the first step in framing plans for sea-works; and to add another to the number of observed facts bearing upon this subject, is the object of the present article.

In the years 1830 and 1831, the writer (then assistant engineer at the Delaware Breakwater,) had occasion to notice particularly, the severity of the action of storms upon such portions of that work as were then elevated above low water mark; the results of these observations we will now detail, merely premising first such brief account of the work itself as seems necessary to a full understanding of the subject.

The Delaware Breakwater was located and begun in 1829; it will, when finished,* consist of two detached dikes of rock, *the Breakwater proper*, a work of 1200 yards in extent, running in a line tangent to the seaward extremity of Cape Henlopen, and commencing at 500 yards distant therefrom; the *ice-breaker*, a work 500 yards long, lying obliquely across the prolongation of the line of the Breakwater, and distant from its western end 350 yards, at the nearest point; the Breakwater lies nearly in the original course of the ebb tide, trending E. S. E. and W. N. W., and will cover the harbour from the northern and eastern winds; whilst the ice-breaker (mainly designed to shelter the anchorage from ice drifting on the ebb,) bears E. by N. and W. by S., and will, at the same time, protect the interior from the winds of the north-west quarter; the contained angle between the horizontal projections of the two works being thirteen of the southern points of the compass, or $146\frac{1}{4}°$.

This artificial harbour is located in Cape Henlopen road, just within the pitch of the Cape, and its site is fully exposed to the sea-winds which blow directly in from the Atlantic ocean, over the whole arc

* If it be completed upon the plan projected by Com. Rodgers, Gen. Bernard, and W. Strickland, Esq., Commissioners; and approved by President J. Q. Adams, on the 27th of Februray, 1829.

comprised between E. S. E. and N. E. by N. around by the East, measuring seven compass points, or $78\frac{3}{4}°$; whilst on the other hand, it is also exposed to winds sweeping an extent, for the most part, of deep water, upon lines of twenty miles long in the Delaware Bay, and including, in their field of action, the whole arc contained between the N. E. by N. and W. S. W., around by the West, being thirteen points, or $146\frac{1}{4}°$; from the W. S. W. around by the South to E. S. E., an arc of twelve points, or 135°; the roadstead is completely landlocked by the shoals of Broadkill, and the main strand in front of the town of Lewes, Sussex county, Delaware.

From the above statement it is evident that the roadstead under Cape Henlopen is wholly exposed to the winds of the north-east quarter, the severest that blow upon the American coast, and which fling upon the strand within the Cape those tremendous billows which are raised by the sweep of the north-east gales over a free range of ocean; whoever has witnessed the fury of these storms upon our sea-coast, will, from these remarks, appreciate the violence of the seas which sweep that perilous road, wherein the writer has himself seen fourteen sail of vessels stranded at the same time, and with the loss of several valuable lives.

The average rise and fall of the tide in Cape Henlopen road is five feet, the highest spring tides, in moderate weather, seven feet, whilst the highest storm tides have been known to attain an altitude of ten feet and more above the plane of low water.

Previous to the month of August 1830, the ice-breaker, at its eastern or seaward end, had been brought up to the shape sectionally indicated by Figure 1: in the centre of the top a stone pier was erected, its shape, a frustrum of a pyramid, $14\frac{1}{2}$ feet long, two and a half feet square in the middle, and weighing seven tons; this was firmly secured on every side by split stone stays of one and a half tons weight, well laid and packed, and the whole of the work then appearing above the water had a flat slope seaward, and was as firmly and compactly formed as was possible with large and rough stone laid without mortar; in the centre of the top of the stone pier (which was elevated ten feet above high water,) a light flag-staff, some twenty feet long, was fixed in a vertical socket, upon a wrought iron pintle fourteen inches long and one and a half inches in diameter.

Figure 1 exhibits the appearance of the work as formed previous to a severe north-east gale which occurred in August 1830.

Figure 2 exhibits the appearance of the work immediately after the gale referred to.

Both of the figures are sketched from measurements made by the writer at the time, and in both O, is the line of common high water, and P, the low water plane.

During this gale a number of heavy stones were swept from the top of the work, and the chief part of the split stone stays, weighing one and a half tons each, were torn from their beds, and transported forty feet to the westward; the stone pier was canted to an angle of 30° with the vertical, and would undoubtedly have been driven over the harbour slope, and lost, if the gale had continued longer; the flag-staff, by the force of the wind and the crests of the billows which swept the work, was forced into the position shown in figure 2, and the wrought iron pintle supporting it, of one and a half inches diameter, *was bent to a right angle!*

The stone pier was soon after replaced, the work rebuilt, and in October, 1830, when the operations of that season terminated, it had been brought up to the shape indicated by the strong or upper lines of Figure 3, the greatest care having been taken to form the whole top surface into a heavy pavement, sloped seaward with a gentle declination, compactly laid, and well wedged with spalls of stone driven by hammers into every crevice; the lower, or broken line of Figure 3, shows the outline of the work as actually found in April, 1831; the storms of the winter of 1830 having denuded the whole space between the two lines, and swept off down the harbour slope, the stone pier of seven tons weight, its split stone stays averaging one and a half tons each, and more than 200 tons of other stone,* many of which exceeded a ton in weight, few being under a quarter of a ton, and all having been previously wedged and compacted together, as has been described.

Thus was the ice-breaker dismantled by the furious winter sea of 1830, whilst the Breakwater proper also suffered severely during the same time; a stone pier of the same dimensions and weight as that we have already described, was landed upon the top of the Breakwater late in the season of 1830, but from want of time was not

* Similar effects have often been produced by storms upon other Breakwaters; thus we find it stated in De La Beche's Geological Manual, that "during the severe gales of November 1824, and again at the commencement of 1829, blocks of lime-stone and granite, from two to five tons weight, were washed about on the Breakwater at Plymouth, *like pebbles;* about 300 tons, in blocks of these dimensions, being carried a distance of two hundred feet, and even up the inclined plane of the Breakwater."

"These blocks were thrown over on the other side, where they remained after the gale scattered in various directions. A block of lime-stone, weighing seven tons, was washed round the western extremity of the Breakwater, and carried 150 feet."

As the experience of the action of the sea upon the Breakwater at Cherbourg was of the same character, it seems unnecessary to quote it; the tendency of the whole is to show that the present mode of relying upon heavy pavements, for the security of the summits of Breakwaters, does not answer the purpose, whilst it seems to inculcate the necessity of forming the coping of such works of a mass of stone of great depth, *so bonded as to gravitate as one body;* as is suggested in a subsequent part of this paper.

erected, and was left laying with its top surface level with high water mark; during a gale of wind in the early part of December of that year, it was moved, broadside foremost, about eighteen feet, and finally in a storm upon the 15th of January, 1831, together with many other heavy stones, it was precipitated down the harbour slope and lost; this work, when closely inspected by the writer, in April 1831, showed that a great many of the surface stones had been arranged by the action of the sea, with their longer axes tending towards the point of the strongest wind, or to the north-east, with their ends often lapping over each other, in form slightly resembling the shingling of a house, and after attaining this position they appeared generally to have maintained it, though it was evident enough that many others had been swept away.

The storms which produced the effects we have recited, though severe, were not remarkably so, and have, without doubt, often been surpassed in violence, by those tremendous easterly storms, which, at intervals of a few years, devastate our coast.

The effects which we have recorded were produced by adequate causes, of which they are in some sort the measure; and it may perhaps be neither uninteresting nor unimportant, in a professional point of view, to enter briefly into a discussion of the mode of action of the sea waves against opposing obstacles, and the proper section which it appears to prescribe for the summits of Breakwaters.

In this connexion the first thing we have to consider is the probable maximum altitude of the waves of the sea. Arnott, in his "Elements of Physics," in referring to the billows created in the ocean at a distance from the land, observes that "no wave rises more than ten feet above the ordinary sea level, which, with the ten feet that its surface afterwards descends below this, gives twenty feet for the whole height, from the bottom of any water valley to an adjoining summit."

This estimate is probably correct, though other writers have asserted that the altitude of the highest waves from the trough to the crest, reaches thirty, or even according to some, fifty feet;* but when we reflect that all the circumstances of a storm at sea tend to inflate our ideas of the magnitude of what takes place, such statements must be received with caution.

Where waves approach a sloping coast, they are borne up by the submerged land, they mount higher, as upon an inclined plane, and finally combing over at the crest, discharge themselves in breakers upon the beach.

* See the number of this Journal for August, 1836. Since writing the above the writer has been informed that the late Frence Exploring Expedition determined this question very accurately in the midst of the Pacific ocean, and fixed the maximum height of waves at 22 feet.

The justly celebrated Smeaton, in his account of the building of the Eddystone Lighthouse, informs us, that during, and immediately after, a severe storm, the billows of the ocean, borne up by the inclined strata of the rocks of the Eddystone, mount to such a surprising altitude as actually to envelope the lantern, at a height of more than eighty feet above the usual surface of the sea, and comb over it, in form similar to the prodigious jet of water which is projected ninety feet into the air, from the great Geyser in Iceland.

Returning from this digression upon the phenomena of waves, we will observe that in the case of Breakwaters, rising abruptly as they do from the bottom of the sea, it seems probable that the augmentation of altitude which waves receive in running upon an inclined coast, is not produced by them, or if at all, in but a slight degree.

The stones forming the summits of Breakwaters, when assailed by the waves of the sea, are solicited by two forces, one acting vertically upward, with the force due to the hydrostatic pressure of a column of water, equal in altitude to the maximum wave which assails the work, and which force we can estimate; the other is the horizontal force due to the progressive motion of the billows, the extent of which we have no means of determining.

We may make a practical application of these views as follows; the heaviest stone used in the construction of the Delaware Breakwater, consisting of Trap-rock, from the Palisades on the Hudson river, weighed 184 lbs. to the cubic foot; whilst the lightest, being the Hornblende rock, from Quarryville, in the northern part of the State of Delaware, weighed but 165 lbs. to the cubic foot;* the average weight of the materials being 175 lbs. per cubic foot, or two and seventh-tenth times heavier than sea water.

Let us assume, according to Arnott, the maximum altitude of waves to be twenty feet, then if we take the case of the Delaware Breakwater, where the storm tides rise ten feet, let *a*, in the annexed sketch, Figure 4, be the top level of the storm tide, *b*, the plane of low water, *c*, the dry rubble foundation of the work thrown promiscuously from vessels into the water, *d*, a mass of stone lying upon the rubble foundation, with its base coincident with the plane of low water, and

* The Hornblende rock referred to, as weighing 165 lbs. to the cubic foot, was the Greenstone from Jaque's quarry. A specimen of Gray Gneiss, from one of Leiper and Crosby's quarries, was found at the same time to weigh 168 lbs. to the cubic foot; and some Black Gneiss from Hill's quarry, on Crum Creek, weighed 177 lbs. per cubic foot. All the specimens of the above rocks, of which the specific gravity was tried by the writer, were broken off from masses of stone delivered at the Delaware Breakwater, in the construction of which all these varieties were then used. The specific gravities of some specimens of similar rocks, from the same quarries, were subsequently found by a committee of the Franklin Institute, to be somewhat greater than is above stated.

e, a wave of twenty feet high, advancing from sea at high water in the direction of the arrow, the crest rising ten feet above the high water plane, and the trough falling ten feet below it; then it is manifest that though whilst the wave is upheaving near the margin of the work, it may not act very powerfully upon substances in front of its base, yet the moment it begins to subside, if it happens to be in the position indicated in the sketch, with its fore foot inserted under the mass of stone, *d*, it will exert upon that mass the upward hydrostatic pressure due to a head of twenty feet, and in an instant after the horizontal force due to the progressive motion of the wave; and thus, as it were, *by successive pulsations*, the waves possess the power of advancing forward immense masses of rock.

Now the upward hydrostatic pressure of a column of sea water twenty feet high, would equal the gravity of a mass of stone weighing 175 lbs. to the foot, if the vertical thickness of the latter were $= \frac{20}{2\frac{7}{10}}$, or near seven and a half feet;* *consequently, if the depth or thickness of the mass of stone were less than seven and a half feet, it would be advanced a little to leeward by each successive wave; but if it were of greater vertical thickness it would stand fast, and resist the hydrostatic and progressive action of waves, not surpassing twenty feet in height.*

Breakwaters are, however, occasionally subject to augmented vio-

* Corroborative of this calculation, we find it stated in Lyell's Principles of Geology, that "on the Isle of Stenness, in the winter of 1802, a tabular mass of stone, eight and one-sixth feet by seven feet, by five and one-sixth feet in depth, was dislodged from its bed, (by the sea,) and removed to a distance of from eighty to ninety feet."

This quotation shows clearly enough that a depth of *more than five and one-sixth feet of stone* is necessary to withstand the action of waves.

A similar circumstance is stated in the public prints to have occurred in a severe storm recently, upon the coast of Massachusetts, near the Boon Island Lighthouse, where "a huge rock twenty-three feet long, sixteen feet wide, and six feet thick," which weighed probably 170 tons, was moved by the waves a considerable distance *up an inclined surface;* evincing there *that a vertical depth of six feet of solid stone* did not possess sufficient stability to resist the force of the sea.

How much more accurately than the moderns, the ancients appreciated the powerful action of waves against sea works, may be inferred by the following paragraph, quoted from Josephus, by Godwin, in the Trans. Instit. Brit. Archts., 1835–6.

"In order to form a port between Dora and Joppa, Herod, in the fifteenth year of his reign, ordered mighty stones to be cast into the sea at twenty fathoms water, to prepare a foundation; the greater number of them fifty feet in length, nine feet deep, and ten feet wide, and some were even larger than these."

Stone of these prodigious dimensions would be very likely to maintain their places in ordinary storms; and their magnitude is in striking contrast to the comparatively small materials used in modern Breakwaters, which, as a necessary consequence, *require incessant repairs.*

lence, from the assault of waves during storms, *owing to the partial removal of atmospheric pressure;* a fact which has recently been observed by James Walker, Esq., F. R. S. &c., President of the British Institution of Civil Engineers, and which was mentioned by him at a recent meeting of that Institute, (as reported in the Civil Engineer and Architects' Journal for September 1841,) in the following words: "At the Plymouth Breakwater, during the great storm in the month of February 1838, several of the largest granite blocks, weighing from three to eight tons each, composing the surface or pavement of the Breakwater, which, although squared and dovetailed into the structure, and embedded in excellent cement to the extent of their whole depth, and thus forming a solid mass, were torn from their positions, and projected over the Breakwater into the Sound."

"Mr. Walker attributed this to the hydrostatic pressure exerted beneath the stones, at the moment when the atmospheric pressure above had been disturbed by the masses of water suddenly and rapidly thrown upon the surface of the Breakwater; blocks of stone were thus often carried to a great distance, not so much by the waves lifting them as by the vacuum created above by the motion of the water, which exerted at the same time its full pressure from below."

And as additional evidence that the formation of a partial vacuum is sometimes a consequence of the envelopment of sea works by high waves, Mr. Walker further stated, "that during a storm in the year 1840, the sea door of the Eddystone Light-house was forced outwards, and its strong iron bolts and hinges broken by the atmospheric pressure from within. In this instance he conceived that the sweep of the vast body of water in motion round the light-house had created a partial and momentary, though effectual vacuum, and thus enabled the atmospheric pressure within the building to act upon the only yielding part of the structure."

As both the above remarkable instances came professionally under the notice of Mr. Walker, we are bound to place the utmost reliance upon the inferences derivable from his statements; and they indicate conclusively that no lateral connexion by dovetails, or otherwise, will compensate for a want of depth of solid stone; but that we must rely for stability in the coping of sea works, chiefly upon the weight of a large mass of materials, *so connected as to gravitate as one body;* we must oppose pressure by weight, and counteract by gravity the action of forces resulting from a disturbed equilibrium.

The pressure of the atmosphere is about the same per superficial foot as would be produced by the gravity of 11½ feet depth of stone weighing 175 lbs. per cubic foot; therefore, if Breakwaters

were liable to be assailed by waves but twenty feet high,* at the same time that the atmospheric pressure *was wholly removed,* their summits would require coping with a depth of stone wrought into a solid mass, equal to $11\frac{1}{2} + 7\frac{1}{2}$, or 19 feet, measured vertically.

In the nature of things, however, we cannot suppose that *the whole pressure* of the atmosphere would ever be removed from any point of the summit of a Breakwater whilst a wave of the maximum height was acting beneath; and though this is very much a matter of conjecture, we may probably infer that under no circumstances would more than two-thirds of the atmospheric pressure be removed from any point; this would be countervailed by a depth of eight feet of stone weighing 175 lbs. to the cubic foot, and as we have shown that a depth of near seven and a half feet is necessary to withstand the hydrostatic pressure of a twenty feet wave, we may finally infer that *the summits of Breakwaters should never consist of less than fifteen feet average depth of stone firmly bound into a solid mass, by clamps, dowels, and cement, so as to gravitate as one body.*†

The fact that continual repairs are rendered necessary, by the blowing up and sweeping away of portions of the pavements of existing

* The maximum height attained by the waves of the most violent storms, at the sites of Breakwaters, is such an important element in forming the plan of the work, that it ought always to be ascertained experimentally, (which would not be difficult,) by attaching a machine upon the principle of a self-registering tide gauge, to a pile well driven at the site, and properly braced against the sea.

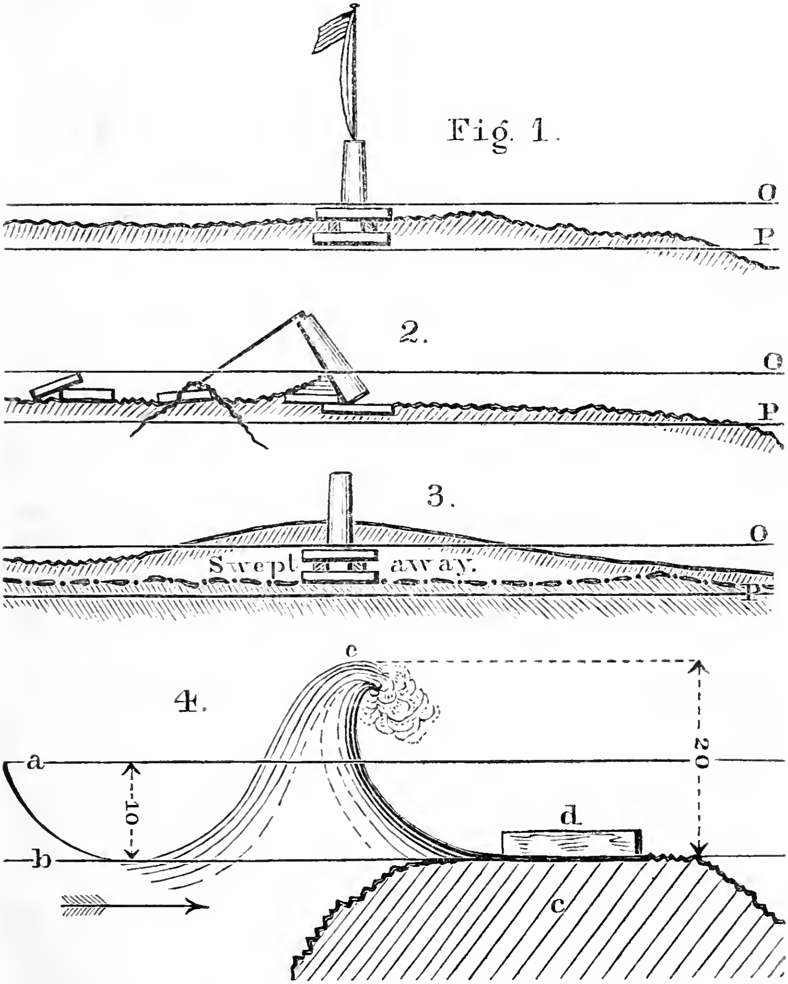
† This principle of constructing sea works, was adopted in Rudyerd's Light-house, built upon the Eddystone, in 1709, and which, after successfully withstanding the storms of half a century, was destroyed by fire in 1759; regarding it, Smeaton states that Rudyerd "judiciously laid hold of the great principle of engineering," that "*weight is the most naturally and effectually resisted by weight,*" and accordingly formed his light-house, near its foundation, *solid,* and mainly of stone, for such a height as he conceived would enable the gravity of the mass to resist the upward hydrostatic pressure of the waves, in case the water insinuated itself beneath the building.

This idea was not lost upon the able and sagacious Smeaton, who, in erecting the famous stone light-house which succeeded Rudyerd's, built the first thirty feet high from the foundation, *solid,* and so proportioned the walls and lantern above the fundamental solid that if their mass were reduced to a cylindrical shape it would add another solid column of about twenty feet in height; so that in opposing the action of the sea, the Eddystone Light-house is equivalent to a solid column of stone fifty feet in altitude.

Now from the above reasoning, 50×2 7-10, or 135 feet, is the altitude of the wave, whose upward hydrostatic action this building is, by its gravity alone, competent to resist; and as the atmospheric pressure is never removed from its summit, whilst the utmost altitude of the jet of water which is sometimes thrown over the lantern is short of 100 feet, its superabundant stability must be manifest.

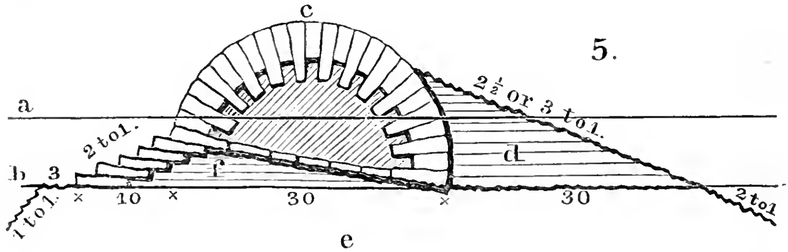
The courses of this celebrated construction being dovetailed and joggled together, so as to prevent movement laterally; as long as its materials are proof against decay, the immutable laws of gravitation will retain it in position, and enable it to defy, as it has for eighty-two years defied, the utmost force of the Atlantic storms; unless, indeed, it should be assaulted by waves more than 135 feet high, which is not within the range of probability.

Breakwaters, during violent storms, strongly sustains the views taken in this paper, and shows but too clearly, that the mass of stone usually combined upon their summits, is deficient in the requisite stability.



The form in which the stone ought to be laid and connected together, should (the writer believes,) be that of a semi-cylinder, the axis lengthwise of the work, and the base laid upon such an inclination seaward as may counteract sliding, and prevent the possibility of its overturning upon the harbour angle, for we know that on a level plane, one half the amount of force will overturn a body which is necessary to lift it.

In the case, then, of a Breakwater similarly situated to that of the Delaware, stone weighing 175 lbs. to the cubic foot, and exposed to the assault of waves not exceeding twenty feet high, it would seem that the section shown in the following Figure 5, would be a proper one.



a, the high water line of spring tides, above which storm tides rise three feet or more; *b*, the plane of low water; *c*, semi-cylindrical mass of stone at least thirty two feet in diameter, thoroughly cemented and bonded together; *d*, fore shore securing the angle of the sea slope, to be mainly formed of cubical blocks of rough stone, weighing at least ten tons each; *e*, the general foundation raised to the low water plane by rubble stone thrown promiscuously into the water from the decks of vessels;* *f*, cemented foundation prepared for the semi-cylinder, and having a top slope seaward of about six feet base to one foot rise.

The advantage of a semi-cylindrical solid (which must average fifteen feet deep vertically) is that if in the construction it is properly bonded on the diameter, with thorough courses of dressed stone, whilst the blocks which form the curved surface are cut like ***arch stone***, no one stone could be by any means extracted from its place if properly doweled laterally, and the whole would resist motion *by its gravity as one solid mass;* the interior backing or hearting of the semi-cylinder would be composed of rubble stone well set in cement mortar, and grouted full in low courses, divided into sections for the purpose.

It is a general idea that the forces acting against a Breakwater are augmented by a great rise and fall of the tide, but from the above reasoning it would appear that such a rise and fall as will allow a wave of the maximum height of twenty feet to exert its greatest energy; or a difference of ten feet between the top water of storm tides and the low water plane, (as exists at the Delaware Breakwater,) *will enable such waves to act with as much power upon sea works as any other variation of tidal surface*, and hence a greater rise and

* Experience at the Delaware Breakwater proved that by this process alone a rough stone work could be brought up with precision to a plane of two feet under the high water of neap tides.

fall than ten feet will not increase, whilst a less one would certainly diminish, the effects of the assailing waves.

The section of the Delaware Breakwater, as planned by the Commissioners appointed by the President of the United States, in 1829, under the act of Congress of May 24th, 1824, was trapezoidal in its general outline, the sea slope having a base of 105¾ feet to a height of thirty-nine feet, and being profiled after the curvilinear figure to which the waves of storms had reduced that of the Breakwater at Cherbourg; the top was fixed at twenty-two feet,* and the internal or harbour slope at one to one, or thirty-nine feet base, the entire base being 166¾ feet to a height of thirty-nine feet; the base of the section which we have proposed as sufficient for a similar work, is 160 feet, and the transverse area would be nearly the same as that of the Breakwater in the Bay of Delaware.

Philadelphia, Nov. 1st, 1841.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cast Iron Rail for the Hiwassee Railroad.† *Designed by* John C. Trautwine, *Civil Engineer.*

To the Committee on Publication.

Gentlemen.—I send you a drawing of a rail which I conceive to possess some advantages over those hitherto employed, and which I shall introduce upon the railroad now under my charge. The great distance of our line from the nearest available shipping port, would have increased the cost of European iron to so serious an extent that our Board of Directors resolved to manufacture their own rails. About $ 110 per ton would have been the cost of English rolled rails, delivered along the line; nor could we obtain any lower bids from our Tennessee iron masters, although advertisements were published for some time, calling upon them for proposals. The principal cause of this was the limited scale of their establishments, which would not admit of their embarking in an enterprize so much more extensive than any of them had been accustomed to.

In furtherance of the object of the Board, the President and myself were deputized to visit the East, with instructions to procure such information, machinery, and workmen, as were essential for the manufacture of our iron, in every department, from the ore to the finished rail.

* With the design of increasing it to thirty feet if subsequently found necessary.

† This road runs from Knoxville, in East Tennessee, to the dividing line between the States of Tennessee and Georgia, where it unites with other lines now under construction, extending to Charleston and Savannah. Its length is 94½ miles.

The result of our investigations was a firm conviction on the part of both, that we could, by the use of coke, make our rails at about $ 60 per ton, or about one-half the price at which we could import them from England.

Having accomplished the object of our mission, the preliminary preparations for erecting the smelting furnaces, and rolling mill, were entered upon; but before much progress had been made in them, I had become so fully convinced of the efficiency and economy of *cast-iron for rails*, that I submitted to the Board a paper, recommending the abandonment of the rolling mill, and the substitution of a cast rail, of the accompanying design, for the rolled bridge rail, which I had first advocated.

My advice was adopted, and a corresponding change made in our plan of operations. Among other things, we decided to use *charcoal* instead of *coke*,* as producing iron of a superior quality for a *cast* rail.

In designing this rail, I availed myself of the results which have, of late years, been elicited from experiments made in both England and the United States, with a view of determining the strongest form of a cast iron beam.

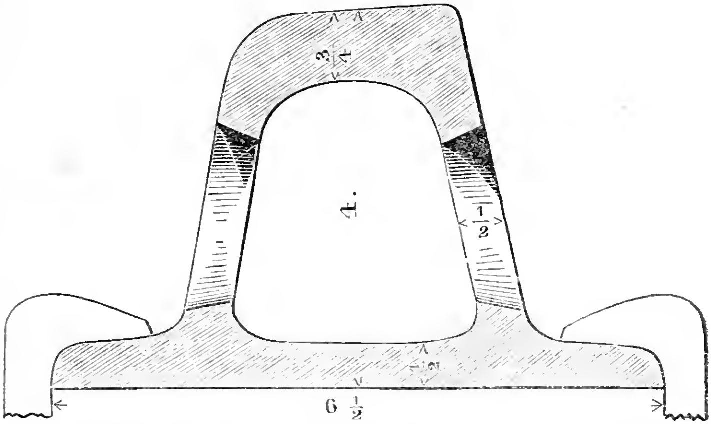
The surprizing discrepancy between these experiments, and the previously received theories, first awakened in me the hope that an effective cast rail might be made of a much less weight than was generally supposed; and although the nature of a rail, (which requires some modifications involving a departure from the strongest form of beam attainable by a given weight of metal,) does not admit of an application of the newly discovered properties of cast iron to their fullest extent, still I suspect I have made a nearer approximation of them than has hitherto been attained. The cases of a rail, and of a girder, are to a great degree analogous; and I have endeavoured to reconcile them so far as their respective functions admitted.

The first point clearly demonstrated, in my opinion, is the necessity of removing as much metal as possible from the vicinity of the neutral axis, and transferring it to the bottom rib, or base of the rail. With this view I introduced the openings in the sides of my rail, (see drawing;) and rejecting the use of the chair, *which contributes*

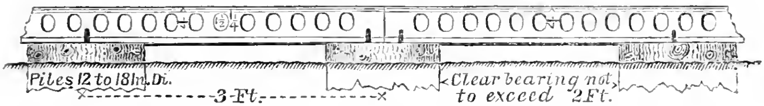
* This change was made at the suggestion of Mr. William Firmstone, now of Pottsville, Pennsylvania, who visited Tennessee for the purpose of designing our furnaces. I introduce his name that I may have an opportunity of expressing the entire satisfaction with which his skill, his readiness to impart information, and his urbane demeanour, impressed the Board of Directors and myself. I trust that his valuable services may meet with constant requisition.

nothing to its strength, I employed both in forming a continuous bottom rib, extending entirely across the rail.

Transverse section. Half size.



Side View.



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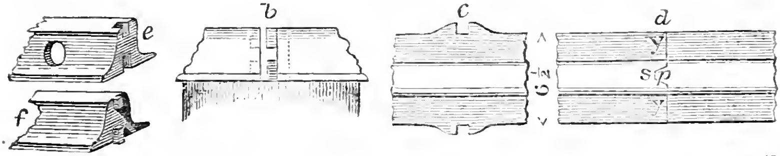


By this arrangement of the metal, I doubt not that a *much stiffer* rail can be made with a given weight of cast iron than of rolled, for the latter does not admit of this modification. Indeed the facility with which the most advantageous form, as deduced from theory, can be imparted to cast iron, constitutes an essential argument in deciding between the comparative merits of it and rolled iron.

Now a very important question is to be considered, viz: can we make a cast iron rail of sufficient strength to resist the accidental percussions to which it must necessarily be subjected occasionally, without the use of so much metal as to raise its cost to that of rolled iron. The answer to this question, of course involves the comparative cost of rolled and cast iron; and in endeavouring to solve it, I shall assume prices, which experience has shown may be safely depended on. Of course, I allude to prices in the United States, and also to the *manufacturing* prices, exclusive of the profits of the iron master; for I am willing to hope that other railroad companies besides ours, may find

it to their interest to make their own rails. Where ore and fuel are easily attainable, there can, in my opinion, be no doubt as to the expediency of their so doing.

For the sake of expediting our inquiry, we will assume that my rail is sufficiently strong for railroad purposes, (as I hope to show it is,) and base our calculations upon it. Now, setting down the price of rolled iron at $ 60 per ton, and that of cast iron at $ 30; and supposing the weight of an efficient rolled rail to be seventy-two* tons per mile of a single track road, and that of the cast rail 110 tons per mile; we have the cost of the former equal to $4,320, or adding the weight of chairs, (say ten tons at $ 30,) a total of $ 4,620; while that of the latter is but $ 3,300; leaving a balance of $ 1,320 in favour of the cast rail, on each mile of single track road. To this difference may fairly be added about $ 200 per mile for the reduced number of spikes gained by rejecting the chairs, so that the balance in favour of the cast rail may be set down at $ 1,500 per mile of single track. Any saving that might accrue in laying down the rails, from dispensing with the labour of fixing the chairs, would be counterbalanced by the increased expense of handling the great weight of the cast rail, and of course should not be taken into consideration. The question of *cost* being therefore settled in favour of cast iron, it remains to inquire whether our assumption of the efficiency of my rail was well founded. And this consideration is, I believe, generally admitted to resolve itself into the single question of its resistance to the *accidental shocks* which occur on every railroad.

The answer to this inquiry, from the limited data with which we are provided for its solution, must necessarily be an empirical one. From all the experiments I have seen recorded, I do not doubt that this rail will bear, with *perfect safety*, a *quiescent* load of at least *ten tons to a wheel;* and that one of *double* that weight would be required to *break it.* Now, it will, in all probability, never be found expedient, in practice, to place more than three tons on a wheel, not even on the driving wheel of a locomotive, for there are considerations which, in my opinion, render it preferable to increase the number of driving wheels, instead of placing more than three tons on any single one. Thus we see that the rail will bear, with *perfect safety*, a *quiescent load* more than three times as great as it will be likely ever to be subjected to, and more than six times as great as would be required to break it. The test load which I intend to apply to my rails, before laying them on the road, will be fifteen tons to a wheel; and should it happen, (as I cannot anticipate,) that that load

*** This is the weight of the rolled bridge rail, which I had adopted before the substitution of the cast rail.**

is too great, I shall, instead of diminishing it, increase the strength of the rail.

But it is the *percussive*, and not the *quiescent* force, against which we must guard. There can be no doubt, I presume, in the mind of any Engineer, that if the rail were required to bear only the quiescent load referred to, the case would admit of no dispute.

To attempt, (with the limited data we now possess,) to *calculate* what this force would be, in any particular instance, might serve as an amusement for abstract mathematicians, but would be attended with results quite as deceptive as their researches into the equilibrium of arches, and many other subjects, in which, for want of *experimental* data, most erroneous assumptions were employed as the basis of their investigations. I hesitate not to say, that with our present data, the query is not susceptible of solution.

"Give me a *fact*, and I'll make you a *theory*," wisely said a certain professor; and in pursuance of his idea, we shall merely present to the reader the following fact. It may be objected that this is a very unsatisfactory mode of determining the point in question. This I admit; and my apology for submitting it, is simply that I know of none more satisfactory.

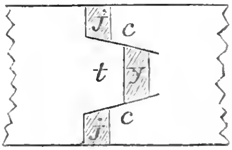
Mr. Strickland, in his reports, (see Strickland's Reports, page 29,) remarks that the best cast rail he saw in England was the elliptical rail used on the Sunderland and Hetton road; on which a traffic of 1,000 tons per day was carried. Now, in comparing these rails with mine, *three very essential* points of difference will be perceived, all favouring the latter, viz: 1st. Mine contains fifty per cent. more metal than the English rail; the latter weighing, without its chairs, seventy-two tons per mile, single track, and mine 110 tons.* 2nd. The form of mine is much better adapted to securing the maximum of strength with the minimum of material. 3rd. The clear bearing of my rail is but *one-half* that of the English. Now I conceive, that supposing the two rails, with their respective weights, to be of the same shape, and to differ in no other respect, mine should even then bear one-half more than the other, making their comparative strengths as one to one and a half. But experiment has shown, that with the proportionate weight of the two rails, the difference of *form* gives a comparative strength of *at least* one to two in favour of mine. This brings up the former proportion to, as one to three. But again the same experiments have shown that the resistances of the rails will be inversely about as their length; this fact still further augments the proportionate difference to, as one to six. In other words, I conceive my rail to be six times as strong as the Hetton rail, pronounced by

*Of 2240 lbs.

Mr. Strickland to be the best *cast* rail he saw in England. It is true, that at the time he wrote his reports, railroads were in their infancy, locomotives were lighter, and their speed less than at the present day, but still no subsequent experience has indicated a necessity for making the cast rail more than six times as strong as those in use at that time.

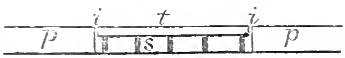
In order to guard as far as practicable, against unusual shocks, I have adopted a form of joint for my rail, which, in connexion with the use of piles firmly driven, will, I suspect, effectually prevent any displacement, and secure a perfectly smooth and unyielding surface for the cars to travel over. This joint is exhibited in figs. *b, d, e*, and it will be seen, on examination, that it secures the ends of any two rails from either *horizontal* or *vertical* displacement, with reference to each other.

I will here mention an advantage of the greatest importance, attending the use of a tongue, which, for what I am aware to the contrary, may be generally known, but which I do not recollect ever to have seen recorded, viz., *that it prevents the wheels from falling into the joints between the rails*, no matter how open they may be. Thus the tongue *t* prevents the wheels from settling into the parts *i i*, of the joint, and the sides *c c*, of the mortise, prevent them from settling into the part *y*; so that if we can only prevent *vertical* displacement at the joinings of the rails, the opening of the joints by contraction and expansion becomes a matter of no importance.



After my rails are spiked down I intend to dress off the joints perfectly by filing, and I expect them afterwards to retain their adjustment. I shall, moreover, append, as a permanent attachment, a strong guard in front of each locomotive, which, by descending to within an inch of the rail, will throw from the track any casual obstruction that would give rise to a dangerous elevation of the wheels.

I have spoken of my intention to test all my rails before permitting them to be laid on the road. The apparatus which I shall use for this purpose is very simple, consisting merely of a loaded car, running on a few feet of permanent and very strong rails, *p p*, which are laid with a sufficient interval, *i i*, to allow of the introduction of the rail to be tested, *t*. The car loaded with fifteen tons to a wheel, is pushed from one permanent rail to the other, passing over *t*, in its transit. By means of this apparatus, I shall be able to ascertain whether my rail requires any modifications before final adoption. I hope too, to be able, before long, to institute a set of experiments on cast iron beams, more full than any hitherto tried.



My adoption of the general form of the bridge rail, instead of the T rail, will, I presume, require no arguments in its favour. Where *cast* iron is used, the question does not involve so much difficulty as in the case of rolled iron.

As the propriety of introducing *cast* iron for rails depends much, if not *essentially*, on the securing of a firm support for it, I intend to reject the common wooden superstructure of mud sills, cross ties, and longitudinal, or string pieces, respecting which I believe almost every engineer will unite with me in saying, that it is *impossible*, (although I do not admire that term,) to joint its several parts so perfectly as to prevent derangement. For this very unstable foundation I shall substitute stout piles, from twelve to eighteen inches in diameter, well *charred*, and driven into the graded surface at intervals of three feet from centre to centre, until their resistance to the ram denotes that all chance of future yielding is prevented. Their heads will be left but some three inches above ground. As the soil of all my embankments is a very firm gravely loam, well compacted in regular layers of but one foot in thickness, I might possibly omit the introduction of *cross ties*, until experience showed whether or not they were necessary. But it is my intention to insert *iron tie rods* believing that they will be found advisable. In cases where the embankments of a road have not been carried up in such a manner as to prevent settlement, I would prefer to drive the piles through to, (or even *into*,) the original surface; for although I look upon piles as being the best of supports for rails, *where they are driven into a firm foundation*, yet I consider them, perhaps, the *worst* of all, when that point is disregarded. I shall resort to *charring* in preference to *kyanizing*, on the score of trouble and expense. Indeed I am not certain, but it is nearly as effective a remedy for rot, especially under ground. The *head of the piles* might, if appearances should indicate its utility, be washed occasionally with a solution of corrosive sublimate, or some other preservative. I do not apprehend that the friction from driving will rub off the charred surface to an injurious extent.

Piles for railroads, will, I doubt not, soon supersede all other foundations. In addition to their perfect efficiency, when properly employed, they form a *cheap* road; cheaper than the ordinary methods of construction. A road of prepared timber, properly driven, securely tied transversely, and carrying a heavy cast rail, will, I venture to say, cost greatly less than many of the roads already constructed in this country, *and be kept in repair at comparatively a very trifling expense. Indeed, until a perfectly unyielding support is found for the rail, and entire inflexibility attained in the rail itself, I conceive railroads to be in their infancy.* Nor do I at all yield assent

to the current opinion, that to attain these desiderata, will be attended by an enormous increase of expense. ***I maintain that railroads have already reached their maximum of cost; and indeed that they have exceeded what is necessary to form a perfect railroad.*** Perhaps hollow *cast iron pipes* might in some instances be substituted for *wooden piles.* They would be far more expensive, but still make a cheaper road than some of the plans most in vogue at the present time. It will not be, until we construct railroads on these principles, getting rid of the annual repairs of *way*, and to a great degree of *cars*, that the railroad system will develope itself in all its glory; and securely bid defiance to the rivalry of canals, steamboats, and turnpikes. The attainment of a smooth, unyielding surface, I consider a matter of paramount importance, even to that of low grades.*

J. C. T.

* Having had no experience in the use of piles *for supporting rails*, and being unwilling to incur any risk of failure by substituting a somewhat novel mode of construction, for one whose merits, and demerits have been fully tested in practice; and moreover, not having the pleasure of a personal acquaintance with any of the Civil Engineers who have been engaged in the construction of *piled* roads in the Eastern States, I gladly avail myself of the medium of this Journal, to solicit from such of them as may be willing to communicate the result of their experience, answers to the following queries. And let me here suggest, that, since the design of establishing a Society of Civil Engineers in the United States has failed, perhaps the principal object of such an institution would be secured, by the general adoption of this mode of seeking information through the Journal.

Query 1st.—Is there any danger that the vibration of the soil, from the passage of trains, may loosen the earth in contact with the piles, so as to allow of the admission of water, or of lateral displacement? especially in curves, and near the edges of embankments?

2nd.—What length of pile has experience proved to be sufficient for the prevention of lateral yielding, in the above cases, (supposing the use of 3×8 cross ties, or of iron rods;) and also in cuts, or a firm natural surface?

3rd.—Are there any roads, or *detached portions* of any road, on which the piles *have not been driven through the embankments entirely down to the natural surface;* and if so, how have they answered.

4th.—Does the security of a piled road against *vertical* displacement fully compensate for its *greater tendency to lateral* motion?

5th.—What is the comparative *annual expense of repairs*, between a piled road and one of the ordinary construction of mud sills, cross ties and strings?

Any replies to these queries, either through the medium of the Journal, or by private letter, will be thankfully received. I should prefer the latter on account of time. Permission to publish might be granted in the letter, and if so I will hand it over to the Actuary of the Franklin Institute. It will afford me much pleasure to reciprocate such favours whenever the opportunity offers.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Blast Furnaces for Iron Smelting. By S. W. Roberts, Civil Engineer. No. 1.

Old Cattawissa Furnace, Columbia county, Pennsylvania. W. C. Leavensworth, lessee. Observations made October 13th, 1841 Working with charcoal and a cold blast.

Stack twenty-eight feet high; lined with slate. Boshes seven feet four inches, and tunnel head sixteen inches in diameter. Hearth stones siliceous conglomerate. Water power from Furnace Run.

Width of trunk fourteen inches, cross section of flowing water half a superficial foot, flows seventy feet at the rate of one foot per second. Falls twenty-five feet. Water equals half a cubic foot per second, or thirty cubic feet per minute. $62\frac{1}{2}$ lbs. $\times 30 = 1875$ lbs., falling per minute, multiplied by twenty-five feet fall $= 46,875$ lbs. falling one foot per minute; being, without deduction for loss, about one and a half horse power of Watt's steam standard. And deducing one-third, according to Smeaton's rule, shows that the power exerted does not exceed *one* horse power, which is very small when compared with the iron made. Water wheel is thirty-two feet in diameter, or one hundred feet in circumference, and turns once in eighty seconds, or at the rate of one and a quarter feet per second. The water is applied twenty-five feet above the bottom of the wheel, which is old and leaky.

There are two single-acting, wooden, blowing-tubs, each six feet five inches in diameter, three feet ten inches stroke; giving six tubs full of air for each revolution of wheel. Area of a tub 32.37 feet; stroke 3.83 feet; contents 124 cubic feet $\times 6 = 744$ cubic feet of air blown per revolution of wheel in eighty seconds; equal *five hundred and fifty-eight cubic feet of cold air per minute*—blown through a single tuyere about two and three-fourth inches in diameter.

Last week the furnace made eighteen tons of grey pig-iron, being 40,320 lbs. of iron. In the week the furnace took one hundred and sixteen charges, called "half-charges." Each half-charge had nineteen boxes of raw ore. (Bloomsburg calcareous ore, broken to the size of Macadamized stone.) Each box contained thirty-five pounds of ore. $35 \times 19 = 665$ lbs. ore $\times 116$ half-charges $= 77,140$ lbs. ore per week. Each half-charge had one box of forge cinder weighing thirty-five pounds $\times 116 = 4060$ lbs. cinder. $4060 + 77,140 = 81,200$ lbs. of ore and cinder, which yielded 40,320 lbs. of iron—being very nearly

fifty per cent. Forty-five pounds of broken limestone to a half-charge $45 \times 116 = 5220$ lbs. limestone per week.

Seven baskets of good charcoal to a half-charge, averaging three and a quarter bushels each, $7 \times 3\frac{1}{4} = 22.75$ bushels $\times 116 = 2639$ bushels charcoal per week, which, divided by eighteen tons of iron made, gives *one hundred and forty-seven bushels of charcoal per ton of iron.*

Eighty-one thousand two hundred pounds of ore and cinder, divided by eighteen, will give four thousand five hundred and eleven pounds, or *two tons and thirty-one pounds of ore, &c. per ton of iron.*

Five thousand two hundred and twenty pounds of limestone divided by eighteen, will give *two hundred and ninety pounds of limestone per ton of iron.*

Estimating twenty pounds of carbon in a bushel of charcoal; $2639 \times 20 = 52{,}780$ lbs. of carbon per week; and five hundred and fifty-eight cubic feet of air per minute $\times 10{,}080$ minutes in a week $= 5{,}624{,}640$ cubic feet of air per week, which divided by fifty-two thousand seven hundred and eighty pounds of carbon, will give *one hundred and six cubic feet of air blown per pound of carbon consumed.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On White Lead. By James C. Booth.

The large quantities of white lead employed as a pigment by our painters, the number of patents which have been issued abroad, proving its extensive employment, the large amount of capital invested in its manufacture, bespeak a material of no ordinary importance, and lead us to enquire whether the processes by which it is produced may not be improved relatively to economy and convenience. Undoubtedly one method by which this end may be attained is by a thorough knowledge of the chemical principles which are involved in its production, ere we can take a higher step in the application of chemistry to its improvement; and it is to this point the following remarks will be directed, by investigating the theory of the processes which are now pursued.

There are three principal modifications of the processes for producing white lead, which will include all the patents that have been granted, subject of course to such variations as secure the privileges of numerous patentees. They are those in which the formation of white lead is in whole, or in part, induced by atmospheric agency, those operating by single, and lastly those by double elective affinity.

I. *Triturating Processes.*—1. The earliest account which I have

been enabled to procure of the manufacture of white lead by the action of atmospheric agents alone, or in chief part, will be found in this Journal, vol. i, 3rd series, p. 158, from which it appears that G. F. Hagner obtained a patent for such a process in 1817. Finely granulated metallic lead was made to revolve in cylinders with water and a portion of vinegar, the air having access; by which means it was converted into a white substance, a mixture of carbonate and hydrate, as we shall find below. When used as a pigment, this white lead was very liable to become yellow, in consequence of which the process was so varied as to fall more evidently under those dependant on single elective affinity. The manufacturers performed upwards of two thousand experiments in the course of five years, and produced an article of such a quality that in 1826 they obtained a premium for it from the Franklin Institute.

2. In 1818, J. Richards obtained a patent for a process on similar principles, excepting that he appears to have employed only lead, air and water, (Jour. Frank. Inst. vol. xxvi, pp. 125, 175.) The white lead was deficient in color and body, as may be seen in the Technical Collection of the Franklin Institute.

3. In the Lond. Jour. of Arts & Science, vol. v, 1835, may be found a patent of Torassa, Muston and Wood, in which granulated lead was shaken in a moistened state on trays and the comminuted gray mass exposed to the air until a white lead was formed. From the date of the patent, 1833, it is very possible that the first ideas of the process were derived from G. F. Hagner, while the latter was in England in 1817–18, (Jour. Frank. Inst., vol i, 3rd series, p. 159.) "It is said that upwards of £100,000 have been expended at Chelsea, by a joint stock company—for executing this most operose and defective process." (Ure's Dict., p. 1300.)

4. Notwithstanding the ill success of these processes, we find another patent, (Jour. Frank. Inst., vol. xxvi, p. 119,) taken out by Homer Holland, in which the same mode of making the white oxide, &c., is claimed by the patentee, excepting that to make the carbonate, he introduces a portion of carbonate of soda into the water. In an amended patent (1838) he claims the use of any alcaline salt or substitute, whose elements consists of oxygen, carbon and hydrogen instead of alcaline carbonates.

5. The Jour. Frank. Inst., vol. xxvi, p. 123, presents another patent by Smith Gardner for making white lead by attrition, with this variation, that the operation is conducted in close vessels into which carbonic acid and air are driven during the attrition, thereby presenting them, says the patentee, "to the suboxide of lead in its nascent state.

"By introducing a very small portion of vapour of vinegar" with the gases, a superior article is at once obtained perfectly free from color.

Before passing to a consideration of the principles involved in the above processes, we may be allowed to remark, 1st. That by a comparison of the dates of the 2nd and 4th patents, it is clear that it would be very advisable for patentees to examine previous patents on the same subject, before they lay open their patent to legal attacks and flaws. 2nd. That by comparing the 3rd patent with the first two, it is evident that a vast amount of capital might be saved by first ascertaining what results others have obtained before we enter the same field of research. 3rd. That the 4th patent shows that to give a clear scientific view of a chemical process, something more is requisite than a superficial knowledge of the science, for in the patentee's first project, he calls the compound produced by attrition of lead a suboxide, and in the amended project he is constrained "to disclaim the opinion, that plumbic pulp, under any circumstances, can be considered a definite compound, and much less an oxide; but that it is a compound of lead, into which the elements, hydrogen, carbon and nitrogen, enter, as well as oxygen." Neither of these views being correct, it would have been better to have avoided such theoretic expressions altogether.

Bonsdorf* exposed a clear surface of lead to moist air which soon coated it with suboxide. A similar piece of lead laid in pure water containing air soon began to form a cloud of hydrated oxide of lead, which dissolved in the water. The smallest quantity of foreign matter, particularly of a saline nature, except nitrates, prevents this action; and so delicate is the test that Bonsdorf thinks it may be employed to try the purity of water, by throwing filings of metallic lead on the surface and observing a few minutes whether the small cloud of hydrate appears; which only occurs when the water is pure. This fact shows why the first project of the 4th patent could not be successful, by introducing a carbonated alcali into the water in which metallic lead was triturated to form an oxide and from that a carbonate, even if there were no other grounds to repudiate such a process. So far from accelerating it must have retarded the operation.

Bonsdorf found still farther that if, instead of permitting the lead to form a hydrate by resting in the water, it were put into a flask and the latter closed up and shaken, suboxide alone formed on the surface. He explains the fact on the theory, that when the lead is at rest, electric currents are formed between the metal and its oxidized points, which determine a higher oxidation, even as far as red lead, according to his observations, while by shaking, the currents are disturbed, and the whole surface of the lead becomes suboxidized, which prevents further oxidation even if left at rest. Hence it follows

* Berzelius Jahresbericht, 1837.

that the lead must first be uniformly suboxidized by trituration, and as it passes into a higher state of oxidation takes up water and carbonic acid, but in the 3rd patent a portion of the oxide and carbonate evidently formed after exposure to the atmosphere. It is probable that in all such cases where carbonic acid is not artificially used, a certain quantity of that acid will be absorbed by the oxides upon exposure to the air subsequent to attrition. The comminuted lead when taken from the trays, where the lead was only moistened, has the dark gray color of suboxide, and first assumes its white appearance by exposure to the atmosphere.

The same chemist exposed a lead plate to moist air until the whole surface was suboxidized, then removed it from a portion of the surface and covered this with water, at which place a vegetation was formed, which he found to consist of one atom of carbonate, and one atom of hydrate of lead. It is therefore a simple hydrocarbonate of lead. This is, in all probability, the substance that is formed in the first four patents, where carbonic acid was not artificially introduced; for where the quantity of this acid is as small as that contained in the atmosphere, and, where the tendency of the lead is also to form a hydrate, it is not probable that this acid should in its very diffused state usurp the place of much of the hydrate.

When vinegar is introduced in these processes, another operation takes place, which induces the more rapid formation of an oxide of lead, preventing at the same time the formation of as much hydrate, and the acetate which forms being simultaneously decomposed by carbonic acid, the vinegar as rapidly passes to another portion of oxide.

In Bonsdorf's experiments the hydrocarbonate was tried as a pigment and found to possess little body, a circumstance which will probably hold good with nearly all white lead made by the above processes, excepting the last, and the modified operations of the first, patent. In the fifth patent carbonic acid is forced in with atmospheric air and probably acts in part catalytically by inducing the formation of oxide, and in part by uniting with the oxide "in its nascent state," and thereby preventing the formation of as large a quantity of hydrate. It is said moreover that the white lead thus obtained is equal to that manufactured by the older processes, (Jour. Frank. Inst., vol. xxvi, p. 125,) but I question whether it will be found to contain a requisite quantity of carbonic acid to prevent its liability to become yellow. It remains to be seen, however, whether by any one of these processes, in which trituration of metallic lead is the chief point, the mingled hydrate and carbonate of lead contains a sufficient amount of carbo-

nate to prevent its becoming yellow by employment as a pigment; for that was the chief difficulty experienced by the first patent, and probably will be an objection to all the others; and it will be shown below that the more highly carbonated the lead is, the less it is subject to this change. The economy of the process of attrition certainly demands attention, as well as the simple arrangements by which it may be effected, but then the question returns, whether the tendency to become yellow by exposure to the atmosphere, or of vapors, can be obviated by giving the highest dose of carbonic acid, partly by driving that gas through the apparatus, and partly by introducing another ingredient into the water employed. If this point be attained, the question may again be asked whether body can be given to the compound, and whether it can be thus made destitute of a crystaline structure, for in the experiments of Bonsdorf, given above, the vegetation evinced a strong tendency to crystalization, and it appears that the same objection is generally urged against white lead made by attrition, viz: it is deficient in body.

If the theory advanced in the fifth patent (Jour. Frank. Inst., vol. xxvi, p. 123) be correct, that the white lead formed by attrition, where carbonic acid is presented to oxide of lead in its nascent state, is possessed of body and a good color, then we may hope that the process of attrition may yet be productive of good results. It should not be forgotten, however, that in all these processes carbonic acid is really present and in considerable quantity, if we suppose a large amount of air to pass over the agitated lead, but then the quantity, relatively to the oxygen of the atmosphere is very small. I would suggest whether it would not be desirable to perform an experiment in a similar manner to the above, in which water may be omitted and due proportions of air and carbonic acid driven through an agitated apparatus containing simply moistened lead, either without or, perhaps better, with the aid of steam, or at a higher than the ordinary atmospheric temperatures.

II. *Processes more or less dependent on Single Elective Affinity.* —These processes all depend upon the decomposition of a subsalt of lead by carbonic acid. 1. Thènard made the first suggestion relative to the principle, and MM. Brechoz and Leseur, who arranged the contrivances for conducting the process, received a prize for their white lead. Neutral acetate of lead was digested with litharge forming a soluble subacetate, through which, diluted with water, was passed a stream of carbonic acid. Carbonate of lead precipitated and there remained a neutral acetate in solution, which being redigested with litharge, again formed a subsalt and was again precipitated as before. Thus the acetate of lead first employed was constantly used

in the operation, a small portion of new material being added each time to allow for accidental loss and waste. All subsequent patents based on a similar principle were derived from the above patent, which was carried out on a large scale by MM. Roard and Brechoz. At this day, a large portion of white lead used in France and Sweden, is similarly manufactured, and the process is also employed in Germany, England, and at one establishment in this country, in Brooklyn, New York. It is generally believed that the old processes for manufacturing white lead by using fermenting tan, &c., and that in which vinegar, air and carbonic acid are driven into chambers containing lead and vinegar, are governed by different principles, but it will be shown that they are essentially the same with those where carbonic acid is passed through a subsalt of lead.

A. Precipitating Processes.—2. It was stated above that G. F. Hagner obtained a patent in 1817 for manufacturing white lead by attrition, but that the quality of the material being inferior, the proprietors varied the apparatus and process in such a manner as to approach Thènard's method. For a more minute description of their plan, see Jour. Frank. Inst., vol. i, 3rd series, p. 158. They forced carbonic acid through a mixture of litharge, pulpy oxide produced by attrition, and vinegar, and their white lead was of such a quality as to receive a medal in 1826.

3. Button and Dyar took out a patent for making white lead, the specification of which will be found in Rep. Pat. Inv. vol. x, 1838, with a drawing illustrating the apparatus. They employed purified carbonic acid from the combustion of coke, which was passed through a mixture of litharge and nitrate of lead dissolved and suspended in water, and kept at the boiling point of water in a state of agitation by the issue of steam in the bottom of the decomposing vats. The carbonate as it formed was drawn up by a pump, suspended in water, and falling on a filter, where it remained, suffered the liquid to fall through into the first vat.

4. In the Jour. Frank. Inst., vol. xxv, p. 197, are remarks on the manufacture of white lead by Mr. Benson who is probably the same one engaged with Mr. Gossage in the manufacture, near Birmingham, England. According to their patent, they employ of vinegar $\frac{1}{300}$ of the weight of litharge, and add so much moisture to the latter that it merely "feels sensibly damp to the touch." Heated carbonic acid (from coke) is passed over this mixture in stone troughs, while the contents are powerfully stirrred up, (Ure's Dict.)

5. Cory's patent in Rep. Pat. Inv., vol. xii, 1839, employs carbonic acid derived from a lime-kiln, introducing it into a chamber, the upper part or ceiling of which is perforated with numerous small holes. A

solution of subacetate of lead is pumped up to the roof of the chamber and falls through the small holes like a shower, absorbing carbonic acid in its descent.

These are the principal variations in the precipitating method of Thènard; all are referable to the same theory, viz., the decomposition of a sub-salt of lead by carbonic acid. The last is evidently the same, excepting that the operation is inverted, and instead of passing carbonic acid through the solution, the latter drops through an atmosphere of the acid. The second is somewhat analogous to the fourth patent, excepting that the latter prescribes less moisture and employs heated carbonic acid. In both, the acid operates by forming carbonate of lead from a part of the oxide in the basic acetate, while the latter, becoming more neutral, is acted upon by the excess of litharge, forming again the basic acetate, which is again decomposed. The third patent employs a basic nitrate of lead, i. e. nitrate of lead and litharge, instead of an acetate, which, together with the boiling state of the solution, constitutes its difference from the others.

According to the observations of Robiquet, Pfaff, and others, the carbonate of lead obtained by precipitation with carbonic acid is a neutral salt, consisting of one atom each of acid and base, the only water present being hygroscopic. In the Bullet. d. Sciences, &c. en Neerlande, vol. i, p. 302, Mulder has shown that the white leads of commerce consist of two atoms of carbonate of lead and one atom of hydrate, but I do not know whether he experimented on white lead precipitated by carbonic acid, among the rest; the probability is that he did, for the process is evidently similar to the older method, in which a fermenting material is employed.

The carbonate of lead formed by these processes, whether similar or not in composition to the ordinary kinds, differs in one essential point, that it will not cover as well, and has less body; and Dr. Ure appears to have first pointed out the cause of this defect; for on examining it microscopically, he found it to consist of small crystaline particles, with a certain degree of translucency. White lead produced by the older methods is superior to it in these respects, which Mr. Benson, and I think justly, refers to "its never having departed from the solid state," and that the particles "have not been at liberty to arrange themselves symmetrically." In his patent, therefore, (fourth,) he employs a quantity of moisture just sufficient to determine the action of the carbonic acid. It is said that Messrs. Gossage and Benson produce forty tons of excellent white lead per week, (Ure's Dict.,)—La Societé d' Encouragement made a large number of experiments on the various kinds of white lead, and came to the conclusion that that produced by precipitation will cover as well as

the others, but requires more coatings, that it has a degree of translucency, but that it is whiter than that made by the older process.'' (Dict. de l' Industrie, &c., Tome iii, p. 164.) It may be that this defect of body may be remedied by violent agitation during the process of precipitation, which would disturb the crystalization. If so, the third patent should produce a dense material, and it is probable that the violent stirring in the fourth may have this effect in addition to its exposing a greater surface to the action of the carbonic acid. We shall dismiss the fifth patent with the remark that the extent of apparatus required is decidedly objectionable, and that it is inefficient, since the liquid must be pumped up several times, and suffered to fall in showers, before the decomposition is sufficiently effected.

There are several points deserving of notice, relative to this mode of manufacturing white lead. The quantity of litharge obtained in different processes of the arts is greater than the commercial demand for it, and as a reconversion of it into metallic lead is attended with a loss of more than one-sixteenth of its weight, it is desirable to find purposes to which it may be directly applied, unattended with loss. These processes for making white lead are of such a character, and hence, if the best quality of white lead cannot now be made by them, it is worth devoting time to their improvement. But, again, there is a much greater nicety in conducting these operations over the old methods, and there may be introduced into them a greater certainty in regard to the amounts of the several materials employed, circumstances which certainly impart some value to them considered with reference to the health and cleanliness of operatives, and to economy to the manufacturer. Of all the processes given above I should be inclined to prefer that of the fourth patent, as being most likely on theoretic grounds to produce the best result. Before closing this portion of our subject, we must make reference to the manufactory at Brooklyn, New York, the only one in this country, as far as my information extends, where Thènard's principle is successfully pursued. The sample of white lead from this establishment, offered at the exhibition of the Franklin Institute last Fall, was considered to be about equal to the others, and spoke well for the method, if it was made on this principle, for I understand they pursue both the older and the precipitating processes.

B. Older processes.—Among these we include the old Dutch method, where a fermenting material was employed, and that which substitutes a heated chamber for the fermenting beds. The oldest among these is probably that which originated in Holland, where rolled sheet lead is placed in earthen pots containing a small quantity of vinegar in the bottom, and these pots then buried in dung, which.

by its fermentation, produces both heat, steam, and carbonic acid. This method being that which is chiefly pursued in this country, we shall not enter into technical details respecting it. The English substitute fermenting tan for dung, otherwise the process is the same. The Kremser white is produced by a variation of the same process. It is conducted in different parts of Austria, particularly at Klagenfurth, in Carinthia, and the lead, which is very pure, is obtained from Bleiberg, in Carinthia. Sheets of lead are hung in small wooden troughs, in the bottom of which is poured mixtures, varying in different establishments, sometimes equal parts of wine lees and vinegar, &c. The troughs, to the number of ninety, more or less, are placed in a chamber, each one closed up, and the whole chamber heated by a furnace to about the temperature of 100° Fahrenheit. If the heat be too high, carbonic acid escapes, and less white lead is the result. It is generally conceded by the best judges that the best Carinthian white lead is superior to all other kinds.

Now if we suppose that twenty-three out of twenty-four hundred weight of lead are converted into white lead, then for these twenty-three hundred weight may be employed nearly 1300 lb. of vinegar, of such a strength that it would convert 128 lbs. of lead into neutral acetate. It is true that in different establishments the relative quantities of vinegar and lead vary, but still the variation is an immaterial point, for the former is rarely more than the fractional part of the lead employed; thus a pint, or a half pint of comparatively weak acid is used to three pounds of lead. It is therefore clearly evident that the former theory, that vinegar both yielded oxygen and carbonic acid, or either one, to form white lead, is either wholly without foundation, or else its service in this respect would produce but a very small part of the white lead, which is actually obtained; or suppose that a bed of 6,000 pots, of ten tier, and 600 in a tier, or layer, contained one pint of vinegar, and three pounds of lead in each, and that the pint of acid contained one ounce of *dry* acetic acid; the whole bed would then contain 18,000 lbs. of lead, and 6,000 oz. of dry acid. But this acid would consist of 2852.4 carbon, 2798.4 oxygen, and 349.2 hydrogen in ounces. Then the 2852.4 oz. of carbon, if converted into carbonic acid, would take up 3,015 lbs. of lead to form a carbonate, or about one-sixth of the metal contained in the bed, while the above amount of oxygen would only take up 2,268 lbs. of lead to make an oxide, or one-eighth of the amount of metal which is present. It follows clearly that the acetic acid is neither employed to yield oxygen for oxidizing, nor carbon for producing a carbonate, to any appreciable extent, and, moreover, it should not be forgotten that a much smaller quantity of vinegar will suffice to produce a car-

bonate than is specified above. The chief products arising from the fermentation of dung are carbonic acid, carbonate of ammonia and water, the second of which may be omitted, as it arises in small quantity from tan, which is employed with success in England. The heat of fermentation then will raise vapour of vinegar, carbonic acid and water; but there is another material of value present in this process, the atmosphere, notwithstanding experiments made in Europe,* which seemed to show that its presence deteriorated the colour of the white lead; for in all the ordinary processes it must be present, and in those which follow it has been shown by direct experiment to be essential to the formation of oxide. The moisture which is present appears to act chiefly by determining the action of the other substances, and not to be decomposed, for we have no evidence of its decomposition, and the changes which ensue to the lead can be satisfactorily explained without it. It may, however, be maintained that it assists in forming oxide, but in the subsequent experiments, air being found necessary, proves that the chief use of the latter is to oxidize the lead. We have shown above that in Bonsdorf's experiments the lead will oxidize in a moist atmosphere, and that the presence of carbonic acid tends to hasten the operation, with the production of a carbonate; acetic acid, then, by its more energetic action, will surely produce an acetate, and where its quantity is small, this will be a sub-salt. But there is carbonic acid also present, and the material must be moist enough to determine its action in decomposing the acetate; while the acetic acid, thus slowly disengaged, will act similarly on another portion of the metal, or its oxide. To this it may be objected, that at length there will be a neutral salt formed, which the carbonic acid cannot decompose. It is, however, shown that this acid will decom. pose even the neutral salt to a certain extent, when it is in solution- It is not, however, necessary to suppose this, for during the length of time required for the conversion of the lead, the whole of the vinegar might be evaporated without its being noticed by its odour above the bed to any appreciable extent, and as each successive portion of acetate is decomposed, a portion of the acid may thus be volatilized and escape into the atmosphere. Another explanation of this presently appears. That acetate of lead is thus formed is shown from the amount of it lost upon washing white lead, which is so great that it becomes a question with the manufacturer whether it might not be re-extracted as acetate, or better in some other form. It may be farther objected that if carbonic acid is thus employed to decompose the generating acetate, why will it not do it, when a piece of the lead in a pot dips into the acid, for in this case only acetate is the result.

* Berzelius' Elements of Chemistry.

To this it may be answered that from the known superior energy of the acetic acid, it forms an acetate with great rapidity, the small crystals of it below acting with capillarity to convey the acid to the upper portions of the metallic coil, while the slowly disengaged carbonic acid can affect the merely moistened crystaline mass with difficulty, and certainly not materially, excepting on its surface. The conclusion, then, is that the process is substantially the same as in Thènard's method, after the lead is oxidized by a moist atmosphere, viz., that a sub-acetate is formed which is simultaneously decomposed by carbonic acid, and that the more neutral salt thus generated being again rendered basic by another portion of oxide is again decomposed, while the final formation of an acid salt is prevented by the gradual escape of a portion of the vinegar. We are not, however, left in doubt as to the latter point, for it has been found that a peculiar etherial substance is obtained during the process, called *acetone*, which may be obtained by passing acetic acid through a heated glass tube, or by the dry distillation of an acetate. It is composed, according to the views of the best chemists, of 3 vol. carbon + 6 vol. hydrogen + 1 vol. oxygen, and its origin from acetic acid may be thus expressed,

1 atom acetic acid, - - -	$4\,C + 6\,H + 3\,O$
Subtract 1 atom carbonic acid, -	$C \qquad + 2\,O$
There remains 1 atom of acetone, -	$3\,C + 6\,H + 1\,O$

so that acetic acid is resolved into acetone and carbonic acid. By heating the neutral dry acetate of lead, it fuses and evolves carbonic acid and acetone to a given point, when it congeals and forms a basic (two-thirds,) acetate, which requires a higher temperature for its decomposition. One-third of the acetic acid in the neutral salt is thus decomposed, and there remains a basic salt.* Now if the above given explanation of the formation of carbonate of lead be correct, then from the middle, towards the close of the process, when a neutral salt will be forming, the constant presence of a considerable amount of heat will tend to form acetone and carbonic acid, the former of which escapes into the atmosphere, while the latter assists in decomposing the basic acetate which remains. The latter is thus re-resolved into a neutral salt to be again subjected to the same decomposition as before. It might be supposed that this theory would account for the formation of all the carbonate of lead, but it has been shown above that the quantity of vinegar is too small as compared with the metallic lead, and from the relative amount of the two, the

* Wöhler in Berzelius' Chemistry, vol. viii, p. 698.

conversion of the greater part of the lead into its carbonate must be explained on Thènard's principle.

These views of the author were first cursorily expressed in a report by the Franklin Institute, (Journal for 1839,) and I find that the same views are held by Mitscherlich, in vol. ii. of his Elements, Berlin, 1840. Benson alludes to a similar view, (Jour. Fr. Inst. vol. xxv. p. 197,) but refers it chiefly to his process, (see above.) I have given my opinions more at large on this subject, since some of the most eminent chemists have advanced the opinion, and I believe it is generally held, that the formation of carbonate of lead by the old process depended mainly on the decomposition of acetic acid.

C. Newer processes.—I have understood that experiments were performed many years since, with the view of making white lead, by the introduction of vapour of vinegar, air, and carbonic acid, into heated apartments containing lead, but as I am unable to find the authority for this, I shall pass to those with which I am acquainted.

Mr. E. Clark took out a patent in 1828 for a process for making white lead in close chambers, heated by steam, into which he introduced carbonic acid and air, the vinegar being in a trough, and running through the chamber, and heated by steam passing through its double bottom, (Jour. Fr. Inst. vol. xxv. p. 232.) Richards' patent was taken out subsequently, and differed in the introduction of steam into the chamber, besides some minor differences of arrangement. I should suppose that the vapourized vinegar would afford sufficient steam, as in the first patent, the object being merely to ensure the action of the other materials.

It will be observed that the process, chemically speaking, is the same in these patents, as in Thènard's method, or the older processes, viz., that an oxide and acetate are formed and decomposed by carbonic acid.

The carbonate formed by the above processes, the older and newer, is composed of two atoms of carbonate, and one of hydrate of lead, but the difference between them and Thènard's lies in the crystaline granular state of the latter, while in the former "the lead has not departed from the solid state," and is therefore more compact or amorphous, and has greater body. A portion of white lead manufactured according to Clark's process was exhibited at the Franklin Institute last Fall, and pronounced equal to the others, it not being known at the time that it was thus manufactured. A sample of Richards' is in the Technical Cabinet of the Franklin Institute.

The main question relative to the newer processes touches their economy, a point which we do not propose to discuss, as foreign to the nature of this essay. Certainly they offer greater neatness of ar-

rangement, and avoid the heavy losses from breakage of pots, while the materials employed are economical, but then again they require their peculiar expenditure for the production of carbonic acid and steam.

III. Processes dependent on double elective affinity.—The principle of these processes is not novel, although various patents have been taken out latterly based upon it, depending on the precipitation of a salt of lead by a carbonated alkali. Some are simple, others of a very complicated character, as the following selections will show.

Hemming's Lond. Jour. vol. xii. Nitrate of soda is decomposed by sulphuric acid, by which nitric acid is obtained, and sulphate of soda. The sulphate of soda is decomposed by charcoal, chalk, &c., and a carbonate of soda produced. The nitric acid first obtained is employed to form a nitrate with lead or its oxide, and this in solution is precipitated by the carbonate of soda. Thus we have obtained a carbonate of lead and nitrate of soda, the latter of which is again decomposed as above. To say the least of it, the process is highly ingenious, and involves not a little chemical knowledge, while like Thènard's process the original salt is recovered, excepting an allowance for accidental waste.

Watt & Tebbutt's patent, Lond. Jour. vol. xiii. Chloride of sodium, (common salt,) and litharge are heated to make chloride of lead. Three parts of the latter are mingled with one of red lead, and sulphuric acid added, while steam heat is applied. There remains sulphate of lead, and chlorine is evolved. The sulphate is then treated with carbonated alkali, which, according to the patent, will make hydrate with a little carbonate of lead, through which carbonic acid is passed, to fully carbonate it. The chloride of lead is also treated with nitric acid, and carbonated in a similar manner. Farther, lead is dissolved in nitric acid, and precipitated by a caustic alkali, or earth. This patent is evidently complicated, perhaps too much so for practical purposes, and unless the patentee employs a mixture of carbonated with caustic alkali, I do not know how he is to obtain a hydrate with a little carbonate; I would rather reverse it, and say carbonate with a little hydrate. By employing red lead with the chloride, the metal is oxidized by it, so that chlorine, and not hydrochloric acid, is the result; but why should the evolution of chlorine be connected with a white lead establishment?

Leigh's patent, Rep. Pat. Inv. vol. xiv, 1840, employs first, nitric acid to act on galena, to obtain a nitrate of lead; 2nd, carbonate of ammonia purified from gas liquor, or from the distillation of organic substances; 3rd, decomposes the nitrate by this carbonate, obtaining carbonate of lead and nitrate of ammonia; 4th, decomposes the sul-

phate, or chloride, of lead by carbonate of ammonia. In consequence of the amount of litharge produced collaterally in several branches of art, the action of nitric acid on galena appears to be no improvement, particularly as a portion of the acid is decomposed and lost, by yielding oxygen to the lead to form the whole of the oxide. If the carbonate of ammonia can be obtained at a cheaper rate than those of soda, or potassa, and of a sufficient degree of purity, the process might be a good one, but this may be questioned, and even if a sulphate or a muriate of ammonia, be obtained, for which there is a ready sale, I question whether the process would then be economical.

It is not necessary to enumerate more of these highly chemical processes, for it must be evident to any one acquainted with the present state of chemical science, that they might be varied "ad infinitum." The main questions are the economy of the processes and the quality of the material produced. In reference to the former point, I would merely remark that I doubt much whether such processes can be successful, where the only object is the manufacture of white lead; they ought to be connected with other chemical manufactures, the various processes of which should be "dovetailed" into each other, so that collateral products may be wrought up to other products of great utility in the arts. I have not yet seen a good analysis of white lead made by these chemical processes, but from my own experiments I believe it will prove to be like the others, a mixture of hydrate and carbonate, for upon precipitating concentrated solutions of carbonate of soda and acetate of lead, carbonic acid is uniformly generated, and escapes with slight effervescence. With a pure basic acetate this does not take place, because the carbonic acid which would have escaped unites with the soda. The decompositions may be thus illustrated.

Carbonate of soda,	$C\,O^2$	-	Carbonic acid.
	$2\,C\,O^2$	-	Basic carbonate of lead.
	$3\,Na\,O$	-	Acetate of soda.
Neutr. acet. of lead,	$3\,\bar{A}$	-	Acetate of soda.
	$3\,Pb\,O$	-	Basic carbonate of lead.
Carbonate of soda,	$C\,O^2$	-	Acet. and carb. of soda.
	$2\,C\,O^2$	-	Basic carb. of lead.
	$3\,Na\,O$	-	Acet. and carb. of soda.
Basic acet. of lead,	$2\,\bar{A}$	-	Acet. and carb. of soda.
	$3\,Pb\,O$	-	Basic carb. of lead.

So that in either case a basic carbonate of lead results, the excess of oxide uniting with a proportion of water to form a hydrate. It would, therefore, appear that the white lead thus produced is similar to that resulting from Thènard's principle, under all its modifications.

Whether it forms as good a pigment as that produced by the older processes I cannot determine, having never heard the results of its application.

Conclusion.—Mulder, (before quoted, Bullet. d. Sci. &c., in Neerlande I., p. 302,) examined a white lead made by a process lately patented by Stratingh, and found it to consist of three atoms of carbonate, and one of hydrate. This method of manufacture, which I have not seen described, has a decided advantage over others, by its not becoming yellow in as short a time when employed as a pigment, and Mulder therefore believes that the hydrated oxide is the principal cause of this change of colour, as sulphuretted hydrogen affects the carbonate less than the hydrate. That this view is correct is shown from the great tendency to become yellow possessed by the compound containing one atom each of carbonate and hydrate. (See the commencement of this essay.) The ordinary carbonates will absorb a certain quantum more of carbonic acid, but never so much as to expel all the water and form a neutral salt. This curious fact seems to show that there is a stronger affinity between the hydrate and carbonate than between carbonic acid and oxide of lead, to form a neutral salt, and from all the above processes it is evident that there is a superior tendency to form a compound, consisting of two atoms of carbonate and one atom of hydrate.

It appears, then, from the preceding, that we are acquainted with at least three distinct varieties of white lead:

Hydrotricarbonate.	-	$(Pb\,O+H\,O) + (Pb\,O+C\,O^2)$
Hydrobicarbonate,	-	$(Pb\,O+H\,O) + 2\,(Pb\,O+C\,O^2)$
Hydrotricarbonate,	-	$(Pb\,O+H\,O) + 3\,(Pb\,O+C\,O^2)$

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A new method of involving Polynomials to any power. By Wm. J. Lewis, Civil Engineer.

Having directed my attention, some months since, to the method given in all our treatises on Algebra, for the involution of expressions consisting of several terms to any power, it occurred to me that a more expeditious mode might be devised, and by pursuing the investigation given below, I discovered the law by which the co-efficient of any term is found.

If we raise, by actual multiplication, any binomial $a+b$ to any power, we soon find:

First.—That the first term of the expression is a raised to the given power.

Second.—That the second term is a affected with an exponent one less than the index of the power multiplied by b, and having for a co-efficient the index of the power.

Third.—That in each succeeding term the exponent of a is one less, and the exponent of b one greater than in the preceding term.

Let an expression $a+b+c+d+e$, consisting of at least as many terms as there are units in the index of the given power, be required to be raised to the fifth power.

From what we have stated in relation to the second term of a binomial, it will be perceived, *by confining our attention to this second term, and disregarding, for the present, all other terms;* that

$$\overline{a+b}^2 = \qquad 2\,a\,b+\&c.$$
$$\overline{a+b+c}^3 = \overline{(a+b)+c}^3 = \qquad 3\,(a+b)^2c+\&c.$$
$$\overline{a+b+c+d}^4 = \overline{(a+b+c)+d}^4 = \qquad 4\,(a+b+c)^3d+\&c.$$
$$\overline{a+b+c+d+e}^5 = \overline{(a+b+c+d)+e}^5 = 5(a+b+c+d)^4e+\&c.$$

Now we know the value of the first term of the development of each of the expressions on the right of the page. Hence, *confining our attention to this first term, and disregarding all the others,* we have;

$$\overline{a+b}^2 = \qquad 2\,a\,b+\&c.$$
$$\overline{a+b+c}^3 = \qquad 3\,(a+b)^2c+\&c. = \qquad 3\,a^2c+\&c.$$
$$\overline{a+b+c+d}^4 = \qquad 4\,(a+b+c)^3d+\&c. = \qquad 4\,a^3d+\&c.$$
$$\overline{a+b+c+d+e}^5 = 5(a+b+c+d)^4e+\&c. = \qquad 5\,a^4e+\&c.$$

Consequently, by substitution, we have

$(a+b+c+d+e)^5$	first	term	a^5
$=5\,(a+b+c+d)^4e+\&c.$	"	"	$5\,a^4e$
$=5.4\,(a+b+c)^3de+\&c.$	"	"	$5.4\,a^3de$
$=5.4.3\,(a+b)^2cde+\&c.$	"	"	$5.4.3\,a^2cde$
$=5.4.3.2\,abcde+\&c.$	"	"	$5.4.3.2\,abcde$

Hence, if $\mathrm{P}=$ co-efficient of $abcde=5.4.3.2$, $\frac{\mathrm{P}}{2}=$ co-efficient of a^2bcd, $\frac{\mathrm{P}}{2.3}=$ co-efficient of a^3bc, $\frac{\mathrm{P}}{2.3.4}=$ co-efficient of a^4b and $\frac{\mathrm{P}}{2.3.4.5}=$ co-efficient of a^5.

If instead of $\overline{a+b+c+d+e}^5$ we had examined the equivalent expression $\overline{e+b+c+d+a}^5$, we should have found as terms in the development e^5, $5ae^4$, $5.4ade^3$,&c., from which we perceive that the co-

efficients of the powers of a multiplied by any number of other terms, are also the coefficients for like powers of each of the other letters multiplied by the same number of other terms.

From the results obtained in the preceding investigation we learn *that the co-efficient of the product of as many letters, as there are units* (n) *in the index of the powers, is* $n.\,n-1\;n-2\ldots 3.2.1$. The introduction of additional terms into the root will not change the value of this co-efficient, as no more than n terms can enter into any expression in the development.

We also remark that a is changed into a^2 by dividing the co-efficient of the term involving a by 2, a^2 into a^3 by dividing its co-efficient by 3, a^3 into a^4 by dividing its co-efficient by 4, &c. Hence we infer generally;

That the co-efficient of a term involving a letter affected with an exponent one greater than in a preceding term, is found by dividing the co-efficient of the preceding term by the greater exponent.

And conversely; *That the co-efficient of a term involving a letter affected with an exponent one less than in a preceding term is found by multiplying the co-efficient of the preceding term by the greater exponent.*

I have demonstrated the truth of these rules for the powers of any letter united to the simple product of other letters. It remains to be proved that it is equally applicable to terms involving combined powers of letters, as a^2c^2e, a^2c^2&c. Let N be the co-efficient of a^2dc^2 and put $c=m+n$, then $\mathrm{N}a^2ec^2=\mathrm{N}a^2d(m+n)^2=2\mathrm{N}a^2dmn+$&c. Hence $\mathrm{N}=\frac{1}{2}$ the co-efficient of $a^2dmn=\frac{1}{2}$ the co-efficient of $a^2cde=\dfrac{\mathrm{P}}{2.2}$.

Again let m be the co-efficient of a^2c^3 and putting $c=m+n$ as before; we have $ma^2c^3=ma^2(m+n)^3=3ma^2m^2n+$&c. Hence $m=\frac{1}{3}$ the co-efficient of $a^2mn=\frac{1}{3}$ the coefficient of $a^2dc^2=\dfrac{\mathrm{P}}{2.2.3}$.

The same process applied to any combination of the powers of the letters, which enter into the development of the involved polynomial, will evidently shew, that the co-efficients are determined by the rules which have been given.

It will also be perceived that all similar combinations of the powers of the different terms, must have like co-efficients, and, consequently, it is only necessary to obtain one of each set of co-efficients to enable us to unite the development of the involved polynomial.

Let us now find all the co-efficients, and express in a series the value of $(a+b+c+d+e)^5$.

Here we have $P=5\times4\times3\times2=120$; and for one set of terms and co-efficients.

$$P\,abcde = 120abcde$$

$$\frac{P}{2}\,a^2bcd = 60\,a^2bcde$$

$$\frac{P}{2.2}\,a^2b^2c = 30\,a^2b^2c$$

$$\frac{P}{2.3}\,a^3bc = 20\,a^3bc$$

$$\frac{P}{2.2.3}\,a^3b^2 = 10\,a^3b^2$$

$$\frac{P}{2.3.4}\,a^4b = 5\,a^4b$$

$$\frac{P}{2.3.4.5}\,a^5 = a^5$$

Hence $(a+b+c+d+e)^5$

$=a^5+b^5+c^5+d^5+e^5$

$+5\ a\,,\ \overline{b+c+d+e}+5\ b^4\ \overline{a+c+d+e}+5\ c^4\ \overline{a+b+d+e}+$
$5\ d^4\ \overline{a+b+c+e}+5\ e^4\ \overline{a+b+c+d}$

$+10\ a^3\ \overline{b^2+c^2+d^2+e^2}+10\ b^3\ \overline{a^2+c^2+d^2+e^2}$

$+10\ c^3\ \overline{a^2+b^2+d^2+e^2}+10\ d^3\ \overline{a^2+b^2+c^{\sim}+{}^2e}$

$+10\ e^3\ \overline{a^2+b^2+c^2+d^2}$

$+20\ a^3\ \overline{bc+bd+be+cd+ce+de}+20\ b^3\ \overline{ac+ad+ae+cd+ce+de}$

$+20\ c^3\ \overline{ab+ad+ae+bd+be+de}+20\ d^3\ \overline{ab+ac+ae+bc+be+ce}$

$+20\ e^3\ \overline{ab+ac+ad+bc+bd+cd}$

$+30\ a^2b^2\ \overline{c+d+e}+30\ a^2c^2\ \overline{b+d+e}+30\ a^2d^2\ \overline{b+c+e}$

$+30\ a^2e^2\ \overline{b+c+d}+30\ b^2c^2\ \overline{a+d+e}+30\ b^2d^2\ \overline{a+c+e}$

$+30\ b^2e^2\ \overline{a+c+d}+30\ c^2d^2\ \overline{a+b+e}+30\ c^2e^2\ \overline{a+b+d}$

$+30\ d^2e^2\ \overline{a+b+c}+60\ a^2\ \overline{bcd+bce+cde}+60\ b^2\ \overline{acd+ace+cde}$

$+60\ c^2\ \overline{abd+abe+bde}+60\ d^2\ \overline{abc+abe+bce}+60\ e^2\ \overline{abc+abd+bcd}$

$+120\ abcde.$

Again, let it be required to find the co-efficients of $(a+b+c)^3$.

Here $P=3\times2=6$, and the following terms involve the required co-efficient; $P\ (6)\ a\,b\,c,\ \frac{P}{2}(3)\ a^2\ b$ and $\frac{P}{2.3}\ (1)\ a^3$.

As a third example, let us find the co-efficients of $(a+b+c+d)^4$.

Here $P=4\times3\times2=24$, and the following terms include the co-efficients; $P\ (24)\ a\ b\ c\ d,\ \frac{P}{2}\ (12)\ a^2\ b\ e\ \frac{P}{2.2}\ (6)\ a^2\ b^2\ \frac{P}{2.3}\ (4)\ a^3\ b$, and $\frac{P}{2.3.4}\ (1)\ a^4$

It is manifest that in all these examples, we could have commenced with the co-efficient of the highest power of a, that is with units, and deduced from thence the remaining co-efficients by successive multiplications and divisions. The expansion of $\overline{a+b+c+d \text{ \&c.}}^n$ will exhibit this process in its most general form; it will be $\overline{a+b+c+d, \text{ \&c.}}^n$

$$=a^n+n\,a^{n-1}b+n.\overline{n-1}\,a^{n-2}b\,c+n.\,\overline{n-1}.\,\overline{n-2}\,a^{n-3}bcd+n.\,\overline{n-1}.\,\overline{n-2}.\,\overline{n-3}\,a^{n-4}bcde+\text{\&c.}$$

$$+n.\frac{n-1}{2}\,a^{n-2}b^2+n.\frac{n-1}{2}\,\overline{n-2}\,a^{n-3}b^2c+n.\frac{n-1}{2}\,\overline{n-2}\,\overline{n-3}\,a^{n-4}b^2cd+\text{\&c.}$$

$$+n.\frac{n-1}{2}\,\frac{n-2}{3}\,a^{n-3}b^3+n.\frac{n-1}{2}\,\frac{n-2}{3}\,\overline{n-3}\,a^{n-4}b^3c+\text{\&c.}$$

$$+n.\frac{n-1}{2}\,\frac{n-2}{3}\,\frac{n-3}{4}\,a^{n-4}b^4+\text{\&c.}$$

If c, d, &c. each becomes o, the root reduces to a binomial, and all the terms containing these letters disappear from our expression of the power. Consequently we have,

$$\overline{a+b}^n=a^n+n\,a^{n-1}b+n\,\frac{n-1}{2}\,a^{n-2}b^2+n.\frac{n-1}{2}\,\frac{n-2}{3}\,a^{n-3}b^3+\text{\&c.}$$

which is the well known binomial theorem. Where the exponent of the power is not much greater than the number of terms in the root it is better to commence with the co-efficient P, supplying the place of the number of terms which are necessary to make the whole number of terms equal to the exponent of the power, by other letters, the value of each of which is of course nothing. The terms involving these letters are evidently nothing, and the only object of their introduction is to facilitate the calculation of the co-efficients of the remaining terms.

Thus were it required to find the co-efficients of $\overline{a+b+c}^5$, they would be most readily found, by first obtaining the co-efficients of $\overline{a+b+e+d+e}^5$, as in our first example, and then rejecting the first two results, which involve d and e. But where the number of terms is small, and the exponent of the power large, it is more convenient to find the co-efficient of a binomial in the usual manner, and obtain from thence the additional co-efficients, which enter into the power in consequence of the introduction of other letters into the root. For an example, find the co-efficients of $\overline{a+b+c}^{10}$. Here the terms involving the binomial co-efficients are $a^{10}+10\,a^9b+45\,a^8b^2+120\,a^7b^3$

$+210\ a^6b^4+252\ a^5b^5$, and the introduction of the third term c gives us the following and similar terms.

$$90\ a^8b\,c+360\ a^7b^2c+840\ a^6b^3c+1260\ a^5b^4c$$
$$+1260\ a^6b^2c^2+2520\ a^5b^3c^2$$
$$+3150\ a^4b^4c^2+4200\ a^4b^3c^3$$

We may also remark that the co-efficient of any term is easily found without regarding the co-efficient of any other term. Thus the co-efficient of $a^5b^3c^2$ in the above example is evidently

$$\frac{10.9.8.7.6.5.4.3.2}{(5.4.3.2)(3.2)2}=\frac{10.9.8.7.6}{3.\ 2.2}=2520.$$

Here the numerator represents the value of P, and the denominators the several divisors used in converting products to squares, squares to cubes, &c. The general expression for the co-efficient of $a^rb^sc^t$ is (putting $n=r+s+t=$ the exponent of the power)

$$\frac{n.\ \overline{n-1}\ \overline{n-2}\ .\ .\ .\ .\ .\ .\ .\ .\ .\ .\ \overline{r+1}}{(s\ .\overline{s-1}\ .\overline{s-2}\ .\ .\ .\ .\ 3.2)\ (t.\ \overline{t-1}\ \overline{t-2}\ .\ .\ .\ .\ 3.2)}$$

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Tatham & Brothers' Lead Pipes.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Patent Improved Leaden Pipe manufactured by Messrs. Tatham & Brothers, of Philadelphia, Pennsylvania, Report:

That they have carefully examined many specimens of these pipes selected by themselves and subjected them to repeated trials by a suitable force pump. The pressure was cautiously increased until the bursting point was attained, in every instance, and the phenomena accurately observed. From the result of these trials the committee are unanimously of opinion that these pipes possess some important advantages over those heretofore used.

1st. *The strength* is equal to the maximum strength of lead due to the form and weight of the tube; thus exhibiting a rare coincidence between theoretical and practical perfection in this respect. The uniformity of the thickness and perfect accuracy of the bore which are attained by the mode of manufacture ensure this invariably. Experiments on the strength of leaden pipes exhibit many discordant and embarrassing characters which have occasioned the Committee some

anxiety. It is well known that the presence of a small proportion of tin, or other metal with which lead is usually alloyed, always affects its hardness and strength—so that pipes made precisely in the same manner, of lead procured from different, and even from the same mines, vary exceedingly in strength. This source of error cannot be ascertained without great difficulty, and the Committee have taken it into consideration.

2nd. *Absence of Flaws.*—As the metal is forced out from the reservoir under enormous pressure, whilst acquiring its form, flaws are avoided, which so often exist in the ordinary castings. It is moreover probable that such pressure whilst consolidating the metal, contributes to its strength.

3rd. *Absence of Scales of Lead and Polish of the Interior.*—These pipes are perfectly clean within, and from the mode of making them must necessarily have this desirable property. The perfect polish also facilitates the motion of fluids.

4th. *Uniformity of Bore.*—The calibre is capable of being made precisely the same throughout, while the common leaden pipes may vary even when made with great care.

5th. *Economy of Metal*—resulting from the concentricity of the interior and exterior surfaces no metal is wasted from variation in thickness.

6th. *The longer lengths* requiring fewer joints, thus diminishing the expense and inconvenience of soldering. These pipes can be made in lengths of from 40 to 300 feet, according to their weight.

7th. Facility of making pipes of large diameter which the Committee believe to be almost impracticable by the ordinary methods, but which may nevertheless be sometimes demanded in the arts.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, Nov. 11, 1841.

Report on Greenough's Patent Lamp and Chemical Oil.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the patent lamp and chemical oil, invented by Mr. B. F. Greenough, of Boston, Massachusetts, Report,

That the lamp is one contrived for the purpose of burning those compounds analogous to camphene, which require for their perfect combustion, a strong draft, and a carefully regulated supply of air.

The lamp consists of an inverted bell-shaped reservoir, through the centre of which passes a tube, open at both ends, the upper end

of which is about one and a half inches above the reservoir, while the lower extremity has a free access to air, as in the ordinary Argand lamp.

This tube, of course, passes air-tight through the reservoir. Concentric with this, and surrounding it, is another metallic tube, starting about one-sixteenth of an inch below the upper edge of the wick, and passing down nearly to the bottom of the reservoir, where it terminates. Into the space between these two tubes, the wick, itself secured upon another tube, passes, and rises about three-fourths of an inch above the upper edge of the inner air-tube. In consequence of this arrangement of the wick, the lamp, when filled, may be inverted, or even rolled over the floor, without losing any of its contents.

The top of the reservoir is made flat, and upon it rests a slightly conical tube, a little more than two inches in height, expanded below into a flat zone, around the circumference of which apertures are provided, for the introduction of the air, which is delivered at the upper end of the tube, around the outer circumference of the flame. Along the axis of the inner air-tube passes a metallic stem, which carries, at its upper extremity, a button, or reverberator, of a diameter rather larger than that of the tube upon which the wick is secured. This button may be raised or lowered at pleasure, by means of the stem, and by it the height of the frame is regulated, and perfect combustion insured. The glass chimney is about one foot in height, swelling slightly at the part opposite the flame, and thence gently tapering to its upper extremity.

By means of the contrivances thus described, a constant and steady access of air is secured to the flame, while the effect of any draught, or sudden current, is in a great measure counteracted. The lamp thus burns steadily, and without any apparent flickering irregularity.

The substance proposed to be burned in these lamps, is what is termed by the inventor, "chemical oil." It is evidently derived from oil of turpentine, but the exact chemical composition of it is, to the committee, unknown.

In regard to the light obtainable from the chemical oil in the lamp thus constructed, as well as the economy to be expected from its use, is subjoined the results of the experiments instituted by the sub-committee.

A lamp containing a pint and half a gill of the oil, was suspended and lit precisely at twelve o'clock. The draught was so regulated as to increase the consumption of the material, as far as it could be done, without giving rise to smoke—and that this was the case, was rendered evident from the odour of the unburned oil, which pervaded the room during the day. At eight and a half o'clock, the wick being

considerably clogged, and the light, in consequence, diminished, the lamp was extinguished, and the consumption was found to be five-eighths of a pint. The cost of the oil being one dollar per gallon. This gives an average expense of nine-tenths of a cent per hour. The inventor states the average expense at one cent per hour.

In regard to the intensity of the light, the same lamp regulated, as far as possible, to the same height, was compared with the Argand gas burner, in the committee room, which is a burner of a little less than three-fourths of an inch, and consists of eighteen jets. This light was estimated by Mr. Cresson to be consuming about four and a half cubic feet per hour, which, at the present price of gas, is an expense of 1.575 cents per hour. The relative intensity of the light, (estimated as proportional to the squares of the distances of the centres of the respective flames, from the centre of the photometer, when the lights were equalised,) was 702.25 for the gas; 1482.25 for the chemical oil; or a little more than two to one in favour of the chemical oil.

By the kindness of Mr. Cresson, the committee were furnished with a remarkably fine Argand lamp, with an adjustable chimney, by means of which the draught of air could be regulated to every height of the wick. With these two lamps the relative intensities were—for the Argand lamp, 495.0625; for the chemical oil, 1122.25; or 2.26 to 1 in favour of the chemical oil.

An experiment was then tried with two of Mr. Greenough's lamps, one being filled with the chemical oil, the other with Dyott's pine oil. The relative intensities were for Dyott's pine oil, 1089; for the chemical oil, 1225; or 1.125 to 1 in favour of the chemical oil.

In these experiments, the distances from the centres of the respective flames to the centre of the photometer, when the lights were equalized, were as follows, viz:

From the gas Argand burner, 26½ inches; from the chemical lamp, 38½ inches.

From the oil Argand burner, 22¼ inches; from the chemical lamp, 33½ inches.

From the lamp with Dyott's oil, 33 inches; from the chemical lamp, 35 inches.

It should also be remarked that the lamps, burning during these experiments for about two and a half hours, exhibited much less clogging of the wick than in the experiment upon the quantity of oil consumed, and the smell was also much less.

The question of the relative adaptation of oils of this nature, and of ordinary sperm oil, for domestic purposes, will be settled by every one, according to their individual impressions in relation to the danger

in using a substance much more inflammable than common oil, and their estimate of the security attainable from care and proper attention.

This question does not seem, to the committee, to be within their province. Perhaps, however, it may be considered that the greater inflammability of the chemical oil is somewhat compensated by the fact that when spilled upon a surface it leaves no stain.

These questions being left for individual consideration, the committee can, with safety and pleasure, recommend Mr. Greenough's lamp, as admirably adapted for the purposes for which it is intended, and as exhibiting a gratifying specimen of our arts in the gracefulness of its design, and the beauty of its finish.

By order of the Committee.

William Hamilton, Actuary.

Philadelphia, Nov. 11th, 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1840.
With Remarks and Exemplifications by the Editor.

1. For improvements in the *Steam Engine applied to Locomotive purposes and Steam Navigation;* John Ericsson, of the Kingdom of Sweden, now residing in New York, November 5.

The claim appended to the specification of this patent will give a sufficiently clear idea of the invention; it is as follows, viz. Having thus fully described the nature of my invention, and shown the manner in which I carry the same into operation, I do hereby declare that I do not claim to be the inventor of steam engines having radial pistons which vibrate or perform partial rotary movements within semi-cylinders, or other segments of cylinders, such engines having been before known and used; but what I do claim as my invention, and desire to secure by letters patent, is the propelling of steam carriages by the combining of two semi-cylinders, each furnished with radial pistons, which pistons vibrate within them, said semi-cylinders being placed on a level with each other; and the shafts, or axles, of their radial pistons extending through the cylindrical covers in opposite directions beyond the sides of a locomotive carriage, and having crank levers attached to their outer ends, which crank levers are connected by suitable rods, to crank pins on the driving wheels. The respective parts being combined and arranged substantially in the manner herein set forth. I likewise claim the employment of the same apparatus for the driving of the propelling, or paddle, wheels of such vessels as are propelled by the power of steam; the general arrangement and operation of the respective parts being substantially the same with those by which said combined semi-cylinders are adapted to the propelling of loco-

motives, with such variations of arrangement only as are required by the nature of the case, and as herein fully pointed out and made known. I also claim the combining of the double semi-cylindrical air-pump with my double semi-cylinder steam engine, constructed and arranged as herein set forth. Said air pump having a radial vibrating piston, and self acting valves, and being arranged and connected with the other operating parts of the engine, substantially as herein described."

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2. For an improvement in *Portable Ovens and Stoves;* Edward Gosselin, city of New York, November 7.

This patent is for adapting a portable and shifting oven to a cooking stove, the draught of which passes under the top plate. The top plate of the stove is provided with two apertures, one near the front, and the other near the chimney; there being a damper in front of the rear aperture, which, when opened, admits the draught to pass directly out at the chimney, and when closed directs it around the oven, the flue of which is made to fit the two openings in the top plate of the stove, so that the draught passes up at one end of the oven, over the top, down the back and out at the chimney.

Claim.—"What I claim as new and of my own invention, and desire to secure by letters patent, is not the mere combination of a portable oven with a cooking stove, as this is not new, but the combining the oven with the stove in the manner herein set forth, so that the draught from the stove shall pass up on one end of the oven, over the top, and down on the opposite end into the common flue of the stove; that is to say, I claim the combination of an oven constructed in the manner herein set forth, with any cooking stove adapted to receive it, and so regulated as to admit the draught either to pass over the oven and thence into the common flue, or to pass directly into the flue without circulating over the oven, the whole being constructed substantially in the manner herein set forth."

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3. For making *Water-proof Trunks;* Peter Getz, Lancaster, Pennsylvania, November 7.

The proposed improvement is adapted to the common trunk, the space in the top, or lid, being made air tight with tinned copper. A box that fits into the body of the trunk, is also made of tinned copper, covered on the top with wood. Into this top is made a hole with a metal ring fitted to it, to receive a cover that screws into this ring, there being a similar ring attached to a copper plate which constitutes the cover. The key hole is made water tight by a screw cap in the same manner with the cover of the box. The whole being thus made water tight, and the upper part or lid of the trunk being an air chamber, the articles contained in the box will not only be preserved from moisture, but the whole may be used as a life preserver.

The claim is confined to the "method described of rendering trunks

water-proof by constructing them with a screwed plate, or lid, in the manner set forth."

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4. For an apparatus for *Cooling Mash in Distilling Operations;* Allen D. Ward, Mason county, Kentucky, November 7.

The improvement which is the subject of this patent is applied to the common mash rake. A water receiver is placed on the top of the rake beam and surrounding the shaft, and another at the bottom of the mash tub, and also surrounding the shaft. Two pipes, one on each side, extend from the upper to the lower receiver; they are curved so as to extend from the upper receiver to the outer rake teeth, in front of which they are then curved and run up in front of the next teeth, and so on until they reach the receiver at the bottom of the mash tub. Water is supplied to the upper receiver and passes through the serpentine pipes to the lower receiver and is discharged at the bottom thereof, and in passing through the pipes, which are carried around with the rake, cool the mash.

The claim is to the "combination of the serpentine pipes and receivers with the shaft for cooling the mash speedily in warm seasons, after the operation of mashing is accomplished."

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5. For improvements in the *Printing Press;* Stephen P. Ruggles, Boston, Massachusetts, November 10.

This press, we are told by the patentee, is principally adapted to small work, such as the printing of cards, and bills. The platen is raised and lowered by a toggle joint, and the types are placed with their face downwards, what is usually called the bed plate, being in this press placed above the platen. The paper is placed on a movable tympan plate, and the impression is given by raising the platen, which first comes in contact with the under side of the tympan plate, and forces it up, with the paper, against the types. The paper is put on and removed, and the types inked by the operation of the machinery, which is all worked by one person; but as the arrangement is necessarily complex, and the claims refer throughout to the drawings, they would not be understood if given.

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6. For an improvement in the mode of *Shifting Switches on Railroads;* Jesse La Rue, Bucks county, Pennsylvania, November 10.

In this apparatus a bar is jointed to the single or double switch, and to this bar is jointed two levers, in opposite directions, and nearly in the middle of the track—when the single switch is used, one lever is placed in the middle of each track. That end of the levers opposite to the end which is jointed to the bar, is weighted to counterbalance the weight of the switch and bar, and properly curved to be acted upon by a cam piece attached to the forward part of the car. By this arrangement the car will always act upon the switch before it is reached by the wheels when running in either direction. The cam

piece which acts on the levers is permenantly attached to the forward part of the car. The end of the rail, and of the switch against which it fits, are beveled so that stones and dirt will not be retained by them.

Claim.—"I am aware that switches have been shifted by the motion of the cars running on the rails leading thereto, and do not therefore claim this as making any part of my invention; but what I do claim, and desire to secure by letters patent, is the combination, in the manner set forth, of the switches, connecting rod, and the two levers, furnished with the curved metallic castings acting as a counterpoise to the weight of the switches, and acted upon by what I have denominated the operating power, (cam piece attached to the car,) whereby the switches may be shifted before they are reached by the car, the same being effected by the car itself, when traveling in either direction, as set forth. I also claim the beveling of the ends of the switches, and of the rails, for the purpose and in the manner above made known."

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7. For a machine for *Cutting Nails, Brads, &c.;* Geo. D. Strong and Jona. Dodge, assignees of Walter Hunt, city of New York, November 13.

This machine is principally applicable to the cutting of nails, such as were patented by Walter Hunt on the 12th of November, 1839, and noticed in the 1st volume, 3rd series, of this Journal, page 18. The cutters are made by turning, or otherwise forming, metallic staves or longitudinal sections of zones, or thimbles, so that their outer peripheries shall represent the form of one half of the nails, or brads. Two such cutters are attached, by their ends, to levers united so as to vibrate together upon gudgeons attached to their outer faces; the centre of vibration of the double lever corresponding to the centre of the circle forming the outer peripheries of the cutters. Two similar cutters, arranged in the same manner, are placed below, so that when the two sets of levers vibrate, the edges of the two sets of cutters just pass each other, they being reversed for that purpose. The cutting edges of the two cutters, on each double lever, are sufficiently far apart to admit of the passage of the bar of iron, from which the nails are cut between them during their vibration. The two sets of levers are connected together by joint links so as to insure their simultaneous vibration. Thus it will be seen that when the two sets of levers are vibrating in one direction, the cutter on one end of the lower set of levers will unite with the cutter on the other end of the upper set of levers in cutting a nail with the head on one side of the bar of iron, and when making the return vibration the other set of cutters will cut the nail with the head on the other side of the bar.

There is a spring gauge to gauge the feed of the bar at every cut—it consists of a long spring attached to the outside of one of the lower levers with a horn, or projection, passing between the two lower cutters.

Claim.—"I claim the plan of forming the cutters for cutting nails, brads, &c., from staves or longitudinal sections of metal zones, or

thimbles, in the form, or forms, specified, whether the same are first made, or turned in entire pieces and afterwards cut, or sawed, into sections, or whether said sections are fitted up separate, or made of cast steel, or other metal. I also claim in connexion with said above described cutters, or those of any other form, having similar shaped cutting surfaces, or edges, the mode of arranging the same in such manner as to operate upon the same principle of motion, that is to say, arranged in two opposite pairs fitted in levers, or other fastenings, by the vibrating motion of which levers two opposite cutters, one from each pair, is made to approximate and pass each other, operating as cylindrical shears in cuting off one nail, and as those recede, the other pair operate in a similar manner in cutting the next nail, alternately. And I further claim the combination and general arrangement of the head knives, cutters, and spring gauge, constructed and arranged as above set forth and described, without reference to the particular form of the cutting edges of the cutters for the purpose of cutting nails, brads, tacks, &c., without regard to the particular form or shape of the same."

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8. For an improvement in *Door Springs;* Wm. W. Smith and Ben. Mullikin, Jr., city of New York, November 13.

From the arbor of a crank having its bearings in a frame attached to the casement of the door, a lever projects, the extreme end of which passes through a loop in an arm attached to the upper edge of the door. The lever is at right angles to the crank, and the crank is actuated by a spiral spring, one end of said spring being attached to the crank and the other to the casement of the door. By this arrangement it will be perceived that the tension of the spring will tend to close the door until it is opened to a right angle, which places the crank in the dead point, and keeps the door open, and when it passes this point the effect will be to force it still further back.

The claim is to the "combination of the spring, crank, and lever, acting upon the arm attached to the door, or gate, in the manner and for the purpose described."

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9. For an improvement in the method of *Manufacturing Balls or Shot;* Levi Magers, city of Baltimore, November 13.

The moulds, which are to be used are made upon the sides of any number of square bars of iron, are arranged in a reciprocating carriage, so that they can be separated at the end of each operation to discharge the balls that have been cast, and then reclosed. For this purpose the bars slide on the carriage at right angles to its length, and all the bars are connected with one lever, each by a separate link, the connecting link of the outside bar being furthest from the fulcrum of the lever, and the others nearer and nearer the fulcrum, so that by one movement of the lever the bars will all be separated. A furnace and kettle, containing the lead, are arranged over the carriage of moulds, and are provided with the necessary appendages to allow the molten lead to run into the moulds as they pass under the kettle, and

to stop its flow when the carriage of moulds arrives at the end of its course.

The claim is to the combination of the furnace and kettle with the moulds, and also to the combination and arrangement of the moulds with the carriage.

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10. For an improvement in the *Windlass Bedstead;* Thomas Lamb, Washington, District of Columbia, November 13.

In this bedstead the rail and post are to be put together by a round tenon and mortise, the mortise being provided with a pin that fits in a groove turned in on the outside of the tenon. A longitudinal groove is cut in the end of the tenon which slips over the pin when the tenon is inserted in the mortise. A segment of a ratchet wheel on the end of the rail, and a pall on the post, constitute the windlass.

The claim is to the above mode of attachment in combination with the windlass.

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11. For a machine for *Sawing Paving Blocks;* Amaziah Nash, Calais, Washington county, Maine, November 13.

The blocks are to be cut by means of a circular saw, and the improvement is in the method of presenting the block to the saw. The block to be sawed is placed on the upper end of a spindle, which has its bearings in a slide, that works in, and at right angles to, the carriage. A frame is either attached to the top or bottom of the slide above mentioned, and when the frame is placed above, the block is shifted, to be cut into any given number of faces, by an index, or "notched wheel and catch," the arbor of which slides up and down by means of a lever to take hold of the block, and when placed below, the spindle on which the block is placed, has a cog wheel on it to form the connexion between the spindle and the index wheel. The carriage feeds the block up to the saw, and the slide, which works at right angles to the motion of the carriage, regulates the diameter of the block.

The claim is to the combination and arrangement of the carriage, slide, index, and saw.

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12. For improvements in the *Cooking Stove;* David H. Hilliard, Cornish, Sullivan county, New Hampshire, November 26.

The improvements described are to be appended to the stove patented by Thomas Woolson, on the 20th of July, 1831, and noticed at page 47 of the ninth volume of this Journal, second series, but they may be applied to other stoves.

The improvements consist in the manner of constructing or arranging the fire chamber, which constitutes what the patentee terms an "air tight furnace." This furnace is adapted to the hearth plate which is sunk like an ash pit, and the anterior part of the bottom is open like a grate, and to this the ash drawer is adapted. The ash drawer is made with a plate in front, so that when it is under the

grate, a draught of air will be admitted to the fire, but when the plate is pushed under the grate, then the draught will be cut off. At the posterior part of this furnace there is an opening which leads to the oven flue of the stove. When the furnace is to be used, this opening is reduced by means of a strip of metal, and when the opening is to be closed entirely it is effected by another strip of metal attached to one edge of a plate which slides on the top of the furnace and is provided with a collar and cover to receive a tea kettle or other vessel. By this arrangement the furnace can be rendered air tight.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner in which I have constructed the bottom of my fire chamber with grated openings through the anterior part thereof, and combined therewith an ash pit drawer having a flat plate in front of sufficient width to cover these openings, and an aperture in the rear for the purpose of admitting air, the whole operating in the manner set forth. And in combination therewith, I claim the strips of metal arranged and operating as described for the purpose of closing the flue space at the back of the fire chamber when required."

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13. For a musical instrument called the *Vocal, or Echo, Organ;* John W. Campbell, Attica, Fountain county, Indiana, November 26.

The object of this improvement is to modify the sound produced by the vibration of a metallic reed, by causing it to pass through chambers, called by the patentee, "vocal, or echo, chambers." Any desired number of these chambers, properly tuned, are arranged in a box which is supplied with wind from a bellows, and the outlets from the chambers are governed by stops attached to keys like those of a piano forte.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the vocal apparatus herein described, consisting of the vocal box with its vibrating tongues, as set forth, and the mouth piece and fauces attached to the same. I also claim the placing of the foregoing vocal apparatus, or such number of them as might be necessary to produce the required notes, in a box constructed in the manner herein described. The said vocal pieces being arranged beside each other and governed by stops, operated by keys for producing tone in the manner herein set forth."

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14. For an improvement in *Churns;* Constant Webb, Wallingford, New Haven county, Connecticut, November 26.

This alleged improvement in churns is in that kind which consists of four wings attached to a horizontal arbor revolving in a box, and instead of having the four wings parallel to the axis, and attached by each end to a head, they are attached to a cross at one end only, and incline from the line of the axis at an angle of about thirty degrees.

Claim.—"What I claim as my invention and desire to secure by

letters patent, is the reel, and the manner in which the agitating wing-boards are arranged upon the arms of the cross, and thus form the peculiar reel of the churn, as set forth in the specification, viz: by attaching to each arm of the cross on the arbor, or axle, an agitating wing, made fast to the arm at one end, and passing the line of the axle obliquely to the left, at an angle of about thirty degrees; each wing being about three inches broad at the end by which it is made fast to the arm of the cross and gradually reduced to about half that width, at the other end, and of such length, and so curved, as to approach but not to touch the sides or bottom of the churn, as more particularly described in my specification."

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15. For an improvement in the *Spark Extinguisher;* David Ritter, New Haven, Connecticut, November 26.

At the top of the ordinary chimney of a locomotive steam engine there is placed a cap, pierced with three holes, one at top, one in front, and the third at the back; the two former have hinged covers, which can be opened for firing up, and the other provided with a conducting tube which runs over the engine and turns down at right angles, and is to discharge the sparks, &c., into a reservoir containing water, and covered with wire gauze for the escape of the draught.

Claim.—"I do not claim as my invention, the conductor for carrying off the sparks from the chimney of the locomotive nor the openings for the draught on the top or in front of it, which openings may be used or not as occasion may require. But I do claim as my invention the combination of the cistern or reservoir of water with the conductor for carrying the sparks and dust from the chimney and depositing them perpendicularly downward in the reservoir, and thereby extinguishing the sparks and absorbing the dust, permitting the smoke only to escape from the reservoir."

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16. For a *Rotary Steam Engine;* Jacob C. Robie, Binghampton, Broome county, New York, November 26.

The engine which is the subject of this patent is very similar to many other rotary engines which have been noticed in this Journal, and as the claims refer to the drawings we will not insert them, but make the following extract from the specification, explanatory of the general combination of the instrument.

"My engine is, in its general construction, similar to some other rotary engines which have been heretofore made; my improvement consists in certain devices by means of which the friction is lessened, the waste of steam is prevented, and the valves against which the steam acts, are so constructed and arranged as to open against permanent bearings, so that their action is more perfect, and their liability to derangement much less, than such as have been heretofore constructed."

17. For *Straining and preserving Clothes Lines;* Edwin Allyn and C. B. Hildredth, Boston, Massachusetts, November 26.

The clothes line to be preserved and strained is to be wound upon a bobbin, or spool, the spindle of which is provided with a winch and ratchet wheel and pall. The spool is enclosed within a case having a sliding door in front. When the line is to be used, the sliding door is to be opened, and the end of the line passed through snatch blocks properly arranged, one of which is double, and then attached to a pin.

The claim is to the "combination of a spool, or bobbin, having a windlass ratchet wheel and catch, with a casing having a slide in front, and also with the single and double snatch blocks."

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18. For a *Thrashing Machine;* John Criswell, Cecil Township, Washington county, Pennsylvania, November 26.

This patent was granted for a mode of arranging that part of a thrashing machine by which the grain is separated from the straw, and the straw itself carried away. Behind the thrashing cylinder there is an inclined rack, made like a venetian blind, or shutter, on which the grain and straw are thrown by the cylinder. The straw is drawn up over this rack by a set of rakes, attached to an endless belt, and is discharged at the upper end of the rack whilst the grain falls through between the slats on to an inclined board, and is thence conducted to a proper receptacle.

The claim is to the "forming of the rack as an inclined plane, and carrying the straw over it by a belt of rakes."

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19. For constructing *Cabooses and other Cooking Stoves;* Loftis Wood, city of New York, November 26.

The following extracts from the specification of this patent will give the reader a very clear understanding of the improvement. "The main feature of my improvement consists in the manner in which I heat the oven used for baking, which oven is situated at the back of the fire place, or chamber of combustion, as in the greater number of cooking stoves; but in my cabooses, or stoves, I do not allow of a direct draught from the fire to pass under the oven, but cause the whole of the heated air generated in combustion to pass over the oven, in a flue space between it and the boilers, or other cooking utensils situated above it; whilst I heat the lower part of the oven by constructing the grate upon which the coal, or other fuel, is sustained, with hollow bars, which bars admit the atmospheric air freely into them in front, and open at their inner or back ends, into a flue space under the oven. I perforate the bottom plate of my oven with holes, so as to allow the atmospheric air which has passed through the grate bars, and has thereby become highly heated, to pass directly into the oven; and I also perforate the back plate of my oven with holes through which the heated air which has been admitted into it may escape into the back flue, and thence, under the government of a

damper, valve, or sliding shutter, into the flue by which it is carried to the chimney.

"What I claim," the patentee further says, "as constituting my invention, and desire to secure by letters patent, is the manner in which I construct and combine the grate bars and the oven, as herein described; that is to say, the forming of my grate with hollow bars, the openings through which lead into the flue space under the oven, for the purpose of heating atmospheric air, and conducting it into said flue space; and in combination therewith. I claim the opening through the bottom and back oven plates, for allowing the air so heated to pass into and through the oven, its passage being governed by a shutter, or damper, as described."

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20. For a *Portable Furnace for Bathing Tubs;* Randolph Densmore, Hopewell, Ontario county, New York, November 26.

The patentee says—"The kind of furnace which I have improved is that which is so constructed as to float in the water contained in the bathing tub, and in which the burning charcoal is below its surface, the fire being fed with air through two tubes branching out from each side of the ash pit." The furnace, as improved, is cylindrical, and a semi-cylindrical tube passes down the middle of it, from near the top to the ash pit, through which the air is supplied to the fire.

Claim.—"Having thus fully described the nature of my improvement, and shown the manner in which I carry the same into operation, what I claim therein as constituting my invention, and desire to secure by letters patent, is the giving to the body of the furnace for the heating of baths, a cylindrical form, and placing the tube, or tubes, channel, or channels, through which air is supplied to the fire, within said body, in the manner and for the purpose herein set forth. And it is to be understood that although I have mentioned a cylindrical form only, as given to the furnace body, I do not intend thereby to limit myself to this particular shape, as the body may be made oval, or polygonal, or be otherwise varied in form, whilst the instrument will remain substantially the same."

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21. For a machine for making *Splints for Friction Matches;* Norman T. Winans and Thaddeus Hyatt, city of New York, November 26.

The patentees say—"Our new manufacture of splints, or sticks, for matches, consists in the making them by pressure and condensation from wood first cut into thin sheets in the manner of veneers; which sheets, or veneers, many be about an eighth of an inch in thickness. In proceeding to manufacture our splints we divide these veneers into portions of the proper size for subjecting them to pressure by means of suitable instruments, which will at the same time condense the wood, and cut it into strips, or splints, preparatory to their being

dipped into sulphur, or into any composition with which they are to be tipped."

The machine which they describe consists of two rollers, mounted like flatting mill rollers, fluted longitudinally, between which rollers the veneers are passed and are thereby cut and pressed into splints, but not quite separated. Two dies properly fluted may be substituted for the rollers.

The claim is to the "manufacturing of splints, or sticks, for matches, of wood condensed by mechanical pressure between rollers, or dies, as described."

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22. For an improved mode of *Regulating the action of the Waste Steam in Locomotives,* to increase or decrease the draught; Ross Winans, Baltimore, Maryland, November 26.

(The specification will appear in the next number.)

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23. For a mode of *Tubing for Sinking Wells* in alluvial soils; Ebenezer Rice, Salina, Onondaga county, New York, November 26.

The tubes which are to be sunk in bored wells, as described in the specification, are to be made of bored wood in sections, and united by means of two metal ferules at each joint, one of them on the outside let in so as to be flush with the wood, and the other let into the end of each piece mid-way between this and the inside. The lower section of tubing, or pipe, towards the bottom of the well, is to be made of iron. A follower, also made of iron, in two parts, and provided with two ears, is placed on the top, and by means of chains attached to these ears, the force is applied for sinking the tube.

The claim is to the "method of sinking wells in alluvial soils, and marshy grounds, by means of wooden tubing formed in lengths, connected together by metal bands, or hoops, sunk in the ends, together with a metal band on the outside, and provided with a metal tube at the bottom, and also the follower on the top, constructed and applied in the manner and for the purpose described."

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24. For an improvement in the *Cut off Valves of Steam Engines;* Wm. A. Lighthall, city of Albany, New York, November 26.

(See specification.)

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25. For a machine for *Skeining Silk and other Thread;* George Heritage, Chestertown, Kent county, Maryland, November 26.

This instrument is for winding a number of skeins on the same reel, one after another without stopping, until the whole surface of the reel is covered. In front of the reel there are two bars with pins in them, as far apart as the distance the skeins are intended to be separated. One of these bars moves up and down by being connected at each end with a crank on a shaft immediately under it. The bobbin, or spool, from which the silk is drawn, is placed obliquely, so that at

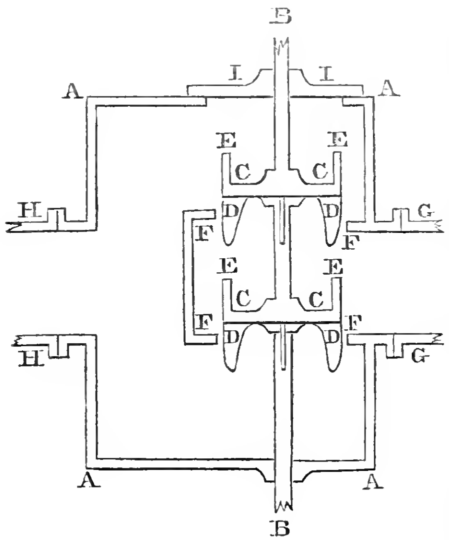
every up and down movement of the bar the silk, or other thread, is shifted one pin, which forms another skein on the reel—at the end of the operation the thread is cut between each skein.

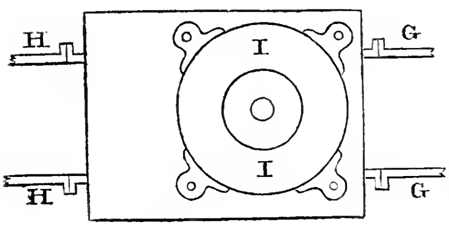
The claim is to the "mode of skeining the silk by the arrangement of the movable and stationary bars and rows of pins in combination with the reel."

Specifications of American Patents.

Specification of a Patent for an Improvement in the Cut-off Valves of Steam Engines. Granted to Wm. A. Lighthall, *city of Albany, New York, November 26th,* 1840.

To all to whom these presents shall come: Be it known that I, the undersigned William A. Lighthall, of the city of Albany and county of Albany, state of New York, have discovered certain improvements in the "half stroke, or cut-off, valve" for steam engines, which I call the "*double plunge half stroke valve,*" and of which the following is a full description.





A, A, A, A, The steam chest; B, B, the valve stems; C, C, the plunge valves of equal diameter, with their rims, or collars, E, E, being three to six inches deep in accordance with the required "throw" and recoil of the valve, thus allowing the valves sufficient play, or motion, while they are in the openings, and still continuing to close them. D, D, four lugs, or guides, upon each valve, having their outer edges gradually tapering inwards towards the stem, or rod, which, together with said stem, or rod, secures the entrance of the valves into F, F, the valves, seats, or openings, which being turned, or bored square instead of beveling or conical, allow the cylindrical formed valves to enter in, and partially through, said openings, and work as

plungers with little or no friction. Thus it will be seen that this valve differs in structure and mode of working from any valves now or heretofore used. The collar part of the valves being cylindrical instead of conical, the lugs, or guides, being sufficiently tapered inwards, and the seat or valve openings being also turned square, or cylindrical, on their edges instead of conical, or beveling, the valves work by plunging into, and partially through, the seat, or opening; the lugs, or guides, are never entirely withdrawn from the openings when lifted, but on the return stroke, or motion, may pass completely through the openings; the collars, or rims, still continuing to close the apertures G, G. The opening to the side pipes, H, H; the opening to the steam pipe I, I. The top view showing the top and bonnet of the steam chest.

The whole apparatus will thus be seen to consist of a cast iron steam chest, or box, A, A, A, A, partially divided by an interior apartment, division, or chest, with apertures F, F, for admitting the steam from the exterior into the interior chest. The valves C, C, play, or work, in those openings, and alternately close and open the communication between the steam apartments. The steam pipe H, H, from the boiler opens into the exterior box, or chest, and the steam pipe G, G, to the cylinder communicates with the interior box, chest, or apartment; when, therefore, the valves are out of the openings the steam is admitted from the exterior chest, or apartment, into the interior, and thence to the side pipes upon the cylinder.

The advantages obtained by my improvements in the cut-off valves as set forth in the specification and drawings herewith submitted, may be thus briefly enumerated.

1st. It shuts off the steam more perfectly than the cut-off valves now in use, and sufficiently perfect for all practical purposes of a half stroke valve.

2nd. It requires less power from the engine to work it, because having two valve plates on one stem of equal superfices it is, when in "situ" in equilibrium floating, as it were, in the steam that surrounds it, the least possible force destroys that equilibrium, and admits the steam. In this respect it is an improvement on the ordinary double balance valve, for that requires the diameter or superfices, of one valve plate larger than the other to keep it in its seat; consequently greater force to displace it, to admit the steam, is necessary.

3rd. It works without noise and consequently obviates the wear and tear from the collision which in the ordinary valves occasion that noise. The conical, or beveled, rims, or edges, of the ordinary double valves strike on their seats and "bring up" with a jar and recoil that soon renders readjustment and repair necessary, and the recoil impairs their effect. If force be applied to counteract recoil, then they "bring up" the harder.

4th. By passing through, instead of on, the seat, these difficulties are obviated—the valve will wear longer without getting out of order, and the collars, or rims, allow it to vibrate (or work up and down) in the openings, still keeping them closed, which is not accomplished in the ordinary half stroke valve.

In the foregoing specification I claim as my invention, or improvement, the combination of two valves working in one stem, constructed as herein described, to wit: with rims, or collars, of sufficient depth to allow the requisite degree of motion while in their seats, and yet continuing to keep the openings closed, and with lugs, or guides, which prevent the valves from being displaced, and at the same time allow the steam to pass freely through the spaces between them.

WM. A. LIGHTHALL.

Notice of Tatham & Brothers Improved Manufacture of Lead, and other Soft Metal, Pipe.

Two patents have been granted within the last year to Messrs. Tatham & Brothers, of Philadelphia, for manufacturing pipes of lead and of other soft metals; the first of these was granted on the 29th of March, 1841, to John Tatham, Jr., and Henry B. Tatham, as assignees of the inventors of the apparatus used, Messrs. John and Charles Hanson, of Huddersfield, England; the last to George N. Tatham and Benjamin Tatham, Jr., of Philadelphia, for improvements on the foregoing; and this is dated on the 11th of October, 1841. An attempt was made in England, some twenty years ago, to manufacture lead pipes upon the same principle with that adopted in the apparatus of the Messrs. Tatham, and a patent was obtained for it; but the means then adopted for carrying the design into effect were defective, in consequence of which the article produced was imperfect, and the pipe never went into general use.

The usual method of manufacturing lead pipes is by first casting, and then drawing them, upon a suitable sized mandrel, through dies, by the aid of a draw-bench; until the introduction of Hanson and Tatham's machinery, this has been the only process successfully practiced in the United States. Although good pipe was frequently made by this method, it was not by any means uniformly so. It has not been found possible to keep the bore of the pipe in the centre of the mass of metal, and its strength was unavoidably unequal, from this cause. In the operation of casting, the metal sometimes becomes faulty in the interior, and such faults are extended in the act of drawing, and are not shown on the surface. The drawn pipes are usually from ten to sixteen feet only in length, and they have rarely been made of a greater diameter than two inches.

We have not only carefully examined the specification of Mr. Hanson's patent, and of that for the improvements devised by the Messrs. Tatham, but we have also seen, and critically inspected, many of the pipes manufactured by these gentlemen, and so far as a judgment can be formed by these means, the article may be pronounced to be perfect; the bore is truly centrical, the interior and exterior surfaces smooth and polished, the metal compact, and the length indefinite. With respect to their strength, we have conversed with the superintendent of the water works at Richmond, in Virginia, who has these pipes in use under a head of two hundred feet of water, has found them uniformly to bear this pressure, and in all respects

superior to other lead pipes. At the Baltimore water works also, we understand that they have been adopted, and are preferred.

We have delayed noticing the patents for this pipe in the expectation of receiving the report of the committee of the Franklin Institute thereon, which we are informed is altogether approbatory; this report we shall probably publish hereafter;* in the mean time it will be satisfactory to our readers to know something of the nature of the manufacture. The lead, or other soft metal, from which the pipes are to be made, is fused, and poured into a very strong metal cylinder, furnished with a piston, and it is suffered to cool therein sufficiently to become set, or to lose its fluidity. The piston is then forced down by means of a very powerful hydraulic press; by this pressure the metal is made to pass through four openings which surround a mandril, or core, on the outside of the cylinder head, and which is of the size of the intended bore; the four solid bars, or strips of metal, which are formed by these openings, are received within a funnel-formed cavity of steel, which surrounds the core, and by the enormous pressure to which they are subjected they are firmly welded together and made to pass out from a cylindrical opening in the funnel-formed cavity, in the state of a finished tube. The tubes thus made may be cut across into wafer-like pieces, which will exhibit a perfect juncture and continuity of the metal.

We do not attempt to describe the particular construction of the apparatus in its details, as this would require several engraved figures; the specifications of the original patent, and of that for the improvements, have been drawn up with much care and clearness, and the claims appear to be made to a construction and arrangement of the parts which are new, and, as we believe, sustainable in law.

Progress of Practical & Theoretical Mechanics & Chemistry.

Adcock's Patent Spray Pump.

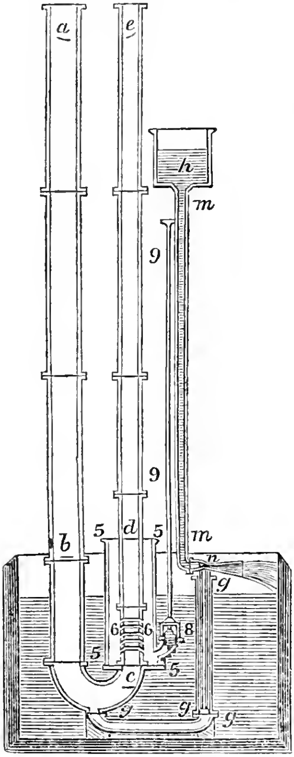
The following extract from a communication by Mr. Adcock, which appeared in the last number of the *Mining Journal,* fully illustrates the construction and action of his patent Spray Pump, of which we inserted a descriptive notice in a recent number.†

"This wood cut is intended to represent and explain a plan put down by me at the 100-yard shaft, at Pemberton, to relieve the bend pipe and lower part of the apparatus from any water that might, from accidental or other cause, be there collected; and as it answers the intended purpose well, I have no doubt that the wood-cut, and its descriptive account, will be gratifying to many of your readers.

"In the wood-cut *a b c* represent a part of the downcast pipe, or the pipe that conveys the air from the top of the pit, or the galleries and workings of the mine, through the bend pipe into the upcast; *b* to *c* the bend pipe, or that which unites at the bottom of the pit the downcast with the upcast; *c d e* the upcast pipe, or pipe through which the air, and the water commingled with it, is carried to the

* Published at p. 49 of this number. † See Jour. Frank. Inst. vol. ii, 3rd series, p. 380.

surface or top of the pit, that the water may be there again collected in a solid body, and thence be allowed to flow freely away; 6 6 represents five slits, through which the water flows from the sump or well at the bottom of the pit into the upcast pipe, when the apparatus is in action, that it may, by the current of air, be dispersed into drops, like drops of rain, and conveyed to the top. The downcast pipe is twenty-nine and a half inches diameter—the upcast pipe seventeen and a half inches; and when not working, and from causes which it is not necessary to explain, water leaks from the sump into the apparatus, to a height equal to the head of the water there, which is about eight feet from the bottom of the bend, or eight feet seven inches from the bottom of the pipe beneath the bend, consequently, the water rises to the same height in the pipe *g g g g*, which is four inches diameter; *m m* is a pipe, twenty feet long, that receives a supply of water from a water ring, placed so as to receive the water that oozes through and trickles down the sides of the pit. This pipe also is four inches diameter, but is unnecessarily large; it terminates in a compound cone marked *n*, as shown in the figure. Of the smaller cone the dimensions may be thus stated:—Its greater diameter, $\frac{96}{100}$th of an inch; its smaller diameter, $\frac{6}{10}$th ditto; and its length $\frac{1}{2}$ ditto. Of the greater cone, the dimensions may be thus stated:—Its smaller diameter, $\frac{6}{10}$th of an inch; its greater diameter, $1\frac{1}{12}$th ditto; and its length $5\frac{4}{10}$th ditto. A pipe, $\frac{6}{10}$th of an inch diameter, descends from the junction of the larger cone with the smaller into the four inch pipe *g g g g*, as shown by the wood-cut. This pipe is nine feet long.



"Having thus given the proportions, I have only to describe the *rationale* of the contrivance:—The water in the pipe *m m*, is maintained by the water ring, or by the water that oozes through and trickles down the sides of the pit to a height or level equal to the height of the pipe itself, or twenty feet. Now, it is well known that the theoretic velocity of water, flowing out of an aperture, is equal to that of a heavy body falling from the height of the head of water, which is found, very nearly, by multiplying the square root of that height in feet by eight, for the number of feet described in a second. Thus, a head of one foot gives eight, a head of nine feet twenty-four, and a head of twenty feet thirty-five and three-fourths feet per second. This is the theoretical velocity; and from what is equally well known respecting the *vena contracta*, or the contraction which all streams undergo when passing through orifices, we must, in order to obtain the actual velocity, multiply the square

root of the height, in feet, by five instead of eight. It is equally well known, from the experiments of Venturi, Bryan Donkin, and others, that when water flows through a compound cone, as exhibited in the wood-cut, the quantity discharged, and, consequently, its velocity, is even greater than that due to the theoretic velocity. But as the twenty feet pipe, under consideration, terminates in an elbow, just before its junction with the double cone, I am quite willing, in order to prevent dispute, to consider the velocity of the water through the double cone as that due to the contraction of the stream. Hence $\sqrt{20} \times 5 = 22\frac{1}{2}$ feet per second, instead of $35\frac{3}{4}$ feet, as above stated.

I have already had occasion to remark, that the diameter of the suction pipe, nine feet long, which passes from the lower part of the double cone into the pipe, *g g g g*, is $\frac{6}{10}$th of an inch; hence the diameter of that pipe being $\frac{6}{10}$th of an inch, and the velocity of the water flowing over it, at its junction with the cone, twenty-two feet per second, the time occupied, or taken up, by any given particle flowing over its diameter, is $\frac{1}{440}$th part of a second—equal, decimally, to .00227 of a second.

"Now, by the laws of gravitation, the space through which a body will fall in a given time, in feet, is as the square of the time, in seconds, multiplied by $16\frac{1}{12}$. Hence, $.00227^2 \times 16\frac{1}{12} \times 12$ in. $= 0001$, very nearly, or about a thousandth part of an inch. Hence, by the laws of gravitation, and considering, at the same time, the expansion of the outward cone, from $\frac{6}{10}$ to $1\frac{1}{12}$ inch diameter, and that, too, in a length of $5\frac{4}{10}$th inches, there is not time, in the passage of the water over the orifice of the $\frac{6}{10}$th inch pipe, for any portion of it to fall into that pipe; hence, as the water flows over the orifice of that pipe with rapidity, it, by its friction or adhesion, or the lateral communication of motion in fluids, withdraws from it some portion of the air, and, subsequently, of the water, so as to produce a partial vacuum. The weight of the atmosphere, in the downcast and upcast pipes of the patented apparatus, then comes into play, and forces the water in those pipes continuously from the pipe, *g g g g*, up the $\frac{6}{10}$th inch pipe, and then through the larger cone, until the surface of the water in the bend pipe, *b* to *c*, gets below the level of the nine feet pipe, and, consequently, is below the bottom of the bend. Thus, Mr. Editor, without valves, clacks, pumps, or any thing that can get out of order, is this important object effected.

HENRY ADCOCK, Civil Engineer.

June 21, 1841.

Mechanics' Magazine, July, 1841.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

New Motive Power.—The Force of Trees agitated by the Wind.

The idea of turning to account, as a mechanical force, the oscillations of a tree by the wind, has never been proposed, because no one,

it is probable, has ever deemed it to be a practicable source of power. A very considerable force, the least costly of all, is thus entirely lost. An attempt has been made to bring it into use by Count de Masing and Paulin Desormeaux, and if they have succeeded, as the ingenious apparatus exhibited at the "*Exposition*" would seem to prove, they will have rendered an immense service to the public, and especially to the inhabitants of the country.

The great difficulty which the inventors have to overcome is to convert into a regular rotary and continuous movement the incoherent and vagabond oscillations of currents of wind issuing from all points of the horizon, and often varying with such rapidity as to box the whole compass in the course of five minutes. The movement must necessarily be double, namely, that arising from the wind and the contrary one from the elasticity of the tree. By reducing the question to its simplest expression, in placing the tree in the centre of a triangle we have three points for the motion of the wind, and three others opposite for the motion of elasticity. The authors have sought to economise by reducing to five the number of their organs; in placing the tree in the centre of a pentagon. From whatever quarter the wind comes and the tree rectifies itself, a lever of the third kind is moved, which transmits its motion by a particular mechanism, to an imbedded arbor, which always turns in one direction, and by means of toothed wheels, bands, or otherwise, transmits the motion to the working apparatus. Hence, in whatever way the tree may move, the work is always going on; and it is only in periods of absolute calm that it ceases to act, being in this respect like the sails of a wind mill or a water wheel during a drought.

The King and all his family had this machine explained to them. It is so simple as to cost in the erection but 250 francs. When a convenient tree is wanting, a flexible pole may be erected on a roof, so as to transmit to the interior its motion by the wind, without any of the trouble of adjustment to the wind, reefing, unreefing, or other preparatories requisite in the common machines.

Recueil, Soc. Polytech.

On the Force of Tension of some Condensed Gases. By M. Bunsen, (Ann. de Pog.)

I first measured the resistance of the glass tubes to be employed. They were entirely filled with water, a small manometer being previously introduced, and then immersed in water heated gradually to boiling, or 100°. This, from the tendency to expansion of the internal water, represents a pressure of 150 atmospheres. When the tubes burst under such a pressure an infinity of longitudinal and parallel fissures were produced, and a sharp sound was heard.

A tube $11\frac{1}{3}$mm. diameter and $1\frac{1}{5}$mm. thick, burst under a pressure of eighty atmospheres, and I have found tubes of smaller diameter which resisted 200 atmospheres. But in time their tenacity is so diminished that some which had sustained thirty atmospheres have suddenly burst with a pressure of scarcely four atmospheres. I attri-

bute this to a diminution of elasticity like that of other bodies, maintained for some time under strong pressure.

Sulphurous acid, cyanogen and liquid ammonia, subjected to pressure in glass tubes containing a manometer, furnished the following tensions calculated in metres of mercury.

Temperatures.	Sul. Acid.	Cyanogen.	Ammonia.
—33.7°			0.949m
—30.0			
—25.0			
—20.0		0.80	
—15.0		1.10	
—10.0	0.78	1.41	
— 5.0	1.11	1.73	3.64
0	1.48	2.07	3.61
+ 5.	1.91	2.44	4.26
+10.	2.89	2.88	4.98
+15.	2.93	3.33	5.78
+20.	3.54	3.80	6.67
+25.	4.20	"	"

Sulphurous acid boils at 10.5° under a baromatic pressure of 0.744m.

Cyanogen becomes liquid at 25°C., and begins to solidify at 30°, assuming a radiated texture. Its boiling point is 20.7° C.

Ammonial gas should be perfectly dried before being liquified. Its boiling point is 33.7° C.

I have tried in vain to liquify by a reduction of temperature as far as 50°, the gas which results from the combination of hydrogen with Chlorine, bromine, iodine and phosphorus.

We may obtain sulphuretted hydrogen in a liquid state by subjecting hyper sulphuret of hydrogen to decomposition in a tube; but for this purpose the presence of a little water is necessary. If we introduce a few pieces of chloride of calcium in tubes, the hyper sulphuret may be preserved intact while the tube remains hermetically closed.

Ann. des Mines, tome 18, Liv. 2, 1840.

Ductility of Glass.

The conservator of the museum of Avignon has remarked that all the glass vases found buried at Vaison, were so soft and ductile when first discovered that they might be kneaded up and cut with a knife blade, but that they resumed the fragility and hardness of common glass after a few hours exposure to the air. This remark applies only to the vases buried at a depth of at least three metres. Ibid.

Decomposition of Organic Substances, by Barytes. By Pelouze and Millon.

Anhydrous barytes removes from organic substances all the carbonic acid which their elementary composition affords; hydrated barytes carries the destruction farther and tend to burn out the carbon, while the hydrogen which proceeds from the substance unites with that coming from the decomposition of the water and is disengaged in a free state. Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1842. COMPUTED BY JOHN DOWNES.*					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
19	13	41	Im. 125 Tauri,	6	93°	
19	14	26	Em.		192	241°
20	5	7	N. App. 792 Baily, 7, ☽ south 2.′0			
29	15	7	Em.		124	
	16	4	Im. A' Scorpii,	5	208	219

* The absence of Mr. Downes on the North Eastern Boundary Exploration prevented the receipt of the announcements for December and January.

Meteorological Observations for November, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	54	72	30.23	30.15	W.	Moderate.		Fog—flying clouds.
	2	51	62	29 86	29 86	W.	do.	.35	Rain—clear.
	3	44	61	.84	.78	W.	do.		Clear—do.
	4	45	42	.60	.60	EW.	do.	.20	Partially cloudy—rain.
☽	5	38	46	.67	.75	W.	Brisk.		Flying clouds—clear.
	6	39	47	.90	30.00	W.	do.		Clear—do.
	7	32	42	30.15	.15	W.	Moderate.	.27	Clear—do.
	8	38	43	.00	29.90	SW.W.	do.		Rain—do
	9	33	46	.20	30.30	NE.	do.		Clear—do.
	10	34	42	.40	.40	NE.	do.	.26	Cloudy—do.
	11	35	43	.34	.20	N.	do.		Cloudy—clear.
⊗	12	44	54	29.70	29 55	S.	do.		Cloudy—rain.
	13	38	48	.55	.55	W.	Brisk.		Clear—flying clouds.
	14	31	52	.50	.50	S.	Moderate.		Clear--do.
	15	34	43	.41	.48	W.	Brisk.		Flying clouds—cloudy.
	16	34	42	.65	.65	W.	Blustering		Cloudy—clear.
	17	32	46	.75	.70	W.	Moderate.		Clear—do.
	18	36	46	.75	.80	W.	do.		Cloudy—do.
	19	30	32	.85	.75	E.	do.	.93	Cloudy—rain.
	20	30	40	.65	.76	NE.	do.		Cloudy—do.
☾	21	39	45	30.06	30 10	W.	do.		Cloudy—do.
	22	44	46	29.90	29.76	SE.	do.	.63	Drizzle—rain.
	23	46	54	70	.70	W.	do.		Clear—do.
	24	34	46	.90	.94	W.	do.		Clear—do.
	25	35	39	30.08	.90	SE.E.	do.	.53	Rain—do.
	26	39	48	29.56	56	EW.	do.	.11	Drizzle—cloudy.
	27	32	31	.85	30.00	W.	Brisk.		Cloudy—flying clouds.
☉	28	24	31	30 26	.28	N.	Moderate.		Partially cloudy—cloudy.
	29	23	29	29.96	29.96	NW.W.	do.	.58	Snow—do.
	30	19	30	30.14	30.24	SW.	do.		Clear—do.
	Mean	35.26	43.48	29.85	29.85			3.86	

	Thermometer.		Barometer.	
Maximum height during the month,	72 00	on the 1st.	30.40	on the 10th.
Minimum " "	19.00	" 31st.	29.41	" 15th.
Mean	39.37		29.85	

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

FEBRUARY, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. Klein, *Civil Engineer.*

[CONTINUED FROM PAGE 10.]

Railroads in Operation and in Progress.

1. *The Budweis and Lintz Railroad* was the first of this kind executed on the continent. The project for the same was begun in 1822 by the late Chevalier de Gerstner, who after having obtained a charter in 1824, formed a company of stockholders in 1825, and commenced the works soon afterwards; for the want of funds, however, they progressed very slowly, and the whole line of eighty miles in length was not completed until the 1st of August, 1832. This railway, the object of which was to connect the Moldau with the Danube and thereby the North Sea with the Black Sea, had to encounter difficulties of no ordinary kind. In regard to its location, the overcoming of a summit 1500 feet above the Danube, and 1000 feet above the Moldau, without resorting to inclined planes, was a difficult problem, which had been solved by Chevalier de Gerstner, (as far as the road has been constructed by himself,) in a manner which does credit to his skill and talents. The greatest inclination from Budweis to the summit is forty-four feet per mile; the smallest radius of curvature 622 feet, and there would, therefore, exist no difficulty of using this part of the line with locomotive steam power. The other half of the railroad, on the contrary, from the summit to Lintz, located and construct-

ed by another engineer, gives evident proofs, that in its execution the directors and engineers were solely governed by the desire of finishing the work at the smallest possible cost, leaving entirely out of view, so far as grades and curvature are concerned, safety of transit, economy in the management of the road, and all those considerations which are essential to give railways advantages superior to those possessed by common turnpike roads. The grades of this part of the line reach the maximum of 115 feet per mile, and the curves have frequently radii of sixty feet.

If there is anything which can justify such a deviation from the principles which ought to prevail in the location of every railroad, it is the embarrassment in which the company found itself in regard to its finances. Confidence in the success of the undertaking having been lost, and a much larger capital, than originally estimated, become necessary for the completion of the whole railroad, new stock had to be issued, and sold at 25 per cent. of its nominal value, that is 75 per cent. below par(!) The capital thus procured was inadequate to complete the road on the plan on which it was commenced.

The total cost of the railway completed has been only $ 827,150, and as its length is eighty miles, the average cost per mile was $ 10,340, which sum includes also the cost of buildings and outfit. To cover these expenses there were emitted

3783	shares at $ 100 - - - - -	$ 378,300
9000	do. (at $ 100) sold at $ 25 - - -	225,000
400	do. were given as a premium on a loan of -	200,000
	Of which $ 6000 is paid back annually.	
1817	shares were finally emitted in 1839, to pay temporary debts and to form an active capital, making in all	
15,000	shares, at the nominal value of - -	1,500,000
	Of the loan contracted there is still due - -	140,000
	Total, - -	$ 1,640,000

This amount being twice as large as the actual expenditure for the railroad, the result must be a proportionate reduction of the productiveness or dividends to the stockholders.

The cost of this railroad must appear very low, if the heavy works, necessary for its graduation, and the circumstance that it was the first work of the kind on the continent, are taken into consideration. The quantity of earth and rock excavated was 2,800,000 cubic yards; 376,000 cubic yards of dry masonry, and 67,000 cubic yards of masonry laid in mortar, had to be executed. The number of bridges

and culverts is not less than 965. The railroad has a single track, with a clear width of three feet seven and a half inches (three and a half Vienna feet,) the superstructure is composed of cross ties six feet in length, flatted on one side and resting upon a bed of stones; of longitudinal sills eighteen feet in length, six by seven inches square, which are fastened in the cross ties by keys, and serve as supports to the flat bars, of two and a half by a half inch. The bars are only nine feet in length, and as no connecting plates were put below the joints, the square ends of the rails are easily pressed into the timber.

With the exception of the mud sills, the superstructure of the first continental railroad is, therefore, the same as that employed much later on so many of the American railroads, and which is now in Europe generally designated by the name of "American Superstructure."

The Budweis and Lintz railroad is worked by horse power, as originally designed; the whole line is divided into six sections of thirteen and a half miles each, and the horse runs daily twice between one section and the next, performing in this manner regularly twenty-seven miles. The time allowed for a trip from one station to another is two and a half hours for passengers, and half a day for freight, so that it takes three days to take goods from Budweis to Lintz, or back. The load drawn by horses varies according to the grades. A wagon weighing one ton is generally loaded with two and a quarter tons of freight, and on a level or moderate grade one horse takes two such wagons; where the grades become steeper three horses are attached to five wagons, two horses to three wagons, finally two horses to two wagons, and on the grade of 115 feet per mile two horses are required to haul up one loaded car. Horses and drivers (the motive power) are furnished by a contractor, who receives one half of the gross income from passengers and one and seven-eighths cents per ton per mile for freight. The latter price is, from time to time, regulated according to the price of oats at the markets of Budweis and Lintz.

The fare is per passenger per mile in first class cars	1.68	cents.
" " " in second "	1.24	"
The charge for freight is per ton per mile from	$2\frac{1}{4}$ to 5	"

The traffic on the road is exceedingly small, the principal object of the same, the connexion of the German ocean with the Black sea, not having been attained yet, as the Moldau, a principal link in this chain of communication, has not yet been improved from its mouth up to Budweis, and the country itself through which the road passes being rather sterile and little populated. The principal article of transportation is salt, which is imported into Bohemia from Upper Aus-

tria. The number of passengers per year is also very small. The following statement exhibits the traffic and net income of the road from the year 1833 to 1840, inclusively.

Year.	Salt carried.	Merchandize, coal, &c.	Total freight	Wood.	Passengers.	Net proceeds.
	Cwt.	Cwt.	Cwt.	Fathoms (120c.)	Number.	Dollars.
1833	....	....	331,609	2733	....	34,028
1834	....	....	450,444	2654	2,379	37,915
1835	320,212	194,040	514,252	1862½	3,887	45,188
1836	352,671	190,431	543,102	2124	3,948	45,755
1837	324,251	168,842	493,093	2538	3,887	40,650
1838	345,647	234,813	580,460	2078	5,454	48,869
1839	392,388	301,737	694,125	3721	10,479	45,887
1840	340,568	315,204	655,772	4364	10,784	....

The present traffic of the Budweis and Lintz railroad consists in about 40,000 tons of freight and 10,000 passengers. The annual net income is $ 45,000, or nearly five and a half per cent. of the cost of construction.

II.—*Lintz and Gmunden Railroad.*

In the year 1832, the continuation of the Budweis and Lintz railroad on the south of the Danube to the town of Gmunden, on the Traun lake, in the vicinity of the great salt works, was undertaken by the same company, and the whole line was finished and put into operation in 1836. This railroad has a length of forty-two miles, and is constructed on the same plan and principle as that from Budweis to Lintz. It rises towards Gmunden with a maximum grade of fifty-three feet per mile; at the terminus near Gmunden, however, it descends with an inclination of one to twenty-two. The track is single, and has the same width as on the Budweis and Lintz railroad; the superstructure is likewise the same. A branch of one and a half miles in length goes from near the terminus at Lintz to Litzlau, on the Danube, where salt and other goods, which are to go down the river, are transhipped.

The total cost of construction of the Lintz and Gmunden railroad was only $ 360,000, (for forty-three and a half miles,) being at an average of only $ 8,267 per mile. The capital for this road was pro-

cured by a loan of $ 325,000, at five per cent. interest, redeemable after ten years in total, or from that period in twenty yearly instalments with interest on the amounts due. The holders of this scrip had besides some privileges relating to the profits of the road, for which they were indemnified by 1036 shares of the Budweis and Lintz railroad.

The traffic of this railway is much greater than of that from Budweis to Lintz. It is also worked by horse power, and the same contractor who furnishes the horses and drivers for the latter road, does also the transportation upon the Lintz and Gmunden line. He receives 0.357 cent per passenger per mile, and 1.6 cent per ton per mile; while the passenger fare is only 1.326 cent in the first class cars, and 0.884 cent in the second class, the charge for freight is from two and a half to four cents per ton per mile according to the value of the articles. In the following statement, the traffic and net income of the railroad from its opening to the year 1840 inclusive, is contained:

Year.	Salt carried.	Merchandize, coal, wood, &c.	Total freight.	Number of passengers.	Net proceeds.
	Cwt.	Cwt.	Cwt.		Dollars.
1836	464,492	143,174	607,666	74,759	21,313
1837	569,232	144,809	714,041	77,905	26,180
1838	601,606	157,687	759,293	90,353	26,869
1839	652,218	156,106	808,324	103,713	30,023
1840	637,963	284,368	922,231	113,672	....

	1839.	1840.
The net income from both railroads was	$ 86,012	87.402
And has been applied as follows, viz:		
Interest on $ 325,000 for the Gmunden road,	16,250	16,250
Do. on the debt for the Budweis and Lintz road ($ 152,000, and $ 140,000 respectively,)	7,600	7,300
Ninth and tenth instalments for the extinguishment of this debt, - - -	6,000	6,000
Dividends, $ 3.75 per share on 15,000 shares,	56,250	56,250
Total, - -	$ 86,100	$ 85,800

If we compare the net profit with the cost of construction of both railroads ($ 1,187,150,) we find it equal to 7¼ per cent. in 1829, and 7⅓ per cent. in 1840. As, however, a great number of shares have been emitted far below their par value, and a part of the loan made

for the Budweis and Lintz railroad is to be paid back annually from the proceeds, the dividends are reduced to 3¾ per cent. The price of the shares is now sixty-five dollars, (instead of $ 100.)

In the whole, the results of the first Austrian railroads may be regarded as very satisfactory; and they ought to encourage to other similar undertakings in less mountainous and more populous districts.

III.—*Railroad from Prague to Pilsen.*

Soon after the Lintz and Budweis railroad was commenced, the project of connecting the capital of Bohemia with Pilsen by a railroad, to be used chiefly for the transportation of wood and coal, was conceived, and in 1826 the works were commenced. The length of the projected line was eighty miles, of which, however, only thirty-five and a half miles, from Prague to the extensive forests of Pirglitz, had been finished, when the company was obliged to sell the road in order to pay the debts, contracted for its establishment. It is now owned by Prince Turstenberg, in whose forest the line terminates.

This railroad, intended like that from Budweis to Gmunden for the use of horse power, has a great many curves and steep grades, the smallest radius of the former is 240 feet, the maximum grade seventy-three and one-third feet per mile, or one in seventy-two; besides there is an inclined plane on the terminus of the line at Prague of one in twenty, and another on the other end of the line of one in forty. The highest summit is 731 feet above the station at Prague, and the length of the railroad exceeds by seven miles that of the turnpike road between the same points.

The superstructure was made of cast iron flat bars, three feet in length, one and a half inches wide and one inch thick, which were fastened upon continuous sills of stone by wooden pins. Experience has proved this to be a very bad plan of construction. The rails frequently broke, and the great number of joints was very injurious to the cars. New cast iron rails of the common T pattern, six feet in length, are now employed wherever the old ones require to be exchanged. The width of track is three feet seven and a half inches.

The road, as far as completed, has cost about $ 150,000, and was sold at $ 40,000. It is now used by the proprietor for the transportation of wood from his own forests to the capital, and of some coal, building materials, &c. One horse hauls up four empty wagons (each weighing two-thirds of a ton) and takes down four wagons, each loaded with two tons. Where the ascent is one to forty, one horse can take only one wagon; on this grade oxen are now more generally employed to haul up the loaded cars. On the inclined plane at Prague the cars are attached together, and go down by their own

gravity, checked in their speed by brakes and a pair of iron dragging shoes. The horses travel twenty-one miles per day; forty-eight horses and three pairs of oxen perform, at present, the whole service. The charges for freight are at the rate of 2.8 to 3.2 cent per ton per mile. In 1840 the motive power on this road cost 1.43 cent per ton per mile.

It is a curious fact, that in Europe as well as in America the first railroads were established in mountainous districts, where great elevations were to be overcome. Like the roads above described, the oldest roads in the United States—the Mauch Chunk, Carbondale and Mohawk and Hudson railroads—are remarkable for their steep grades and inclined planes.

[TO BE CONTINUED.]

On the Cost of Hauling Stone by four horse wagons, over the common dirt roads of the country. By ELLWOOD MORRIS, C. E.

The following formulæ—founded upon experimental data—have been found useful by the writer in determining one element of the cost of masonry, when the distance of the work from the quarry is known, and the road between the two, presents no greater difficulties than the ordinary dirt roads of the country usually do.

We are aware that in framing an equation to express mathematically the cost of haulage, the grade and character of the road ought to be precisely fixed in the formulæ, and therefore that the phrase *common country road*, conveys but an indefinite meaning; yet practically the term is pretty well understood, and its purport is in a measure fixed in our formulæ, by the load which is assigned therein to a four horse wagon.

If it be found, by inquiry from residents along the road to be used, that either a greater or a less load than that of the formulæ, can probably be hauled by the prescribed team, it is only necessary to substitute a corrective number, and the equation will still give satisfactory results, as the other elements are invariable, or nearly so, in their application to the dirt roads of the country.

It was ascertained, by experiment, that including the time lost in breathing the horses upon the hills, in applying the drag chain, &c., the wagons traveled at an average rate of $2\frac{2}{10}$ miles lineal, *or* $1\frac{1}{10}$ *miles of trip per hour*, the word *trip* meaning traveling twice over the same distance.

Averaging good and bad weather the wagons hauled at each load as much limestone as (inclusive of waste) made *one perch of twenty-five cubic feet* when laid in the wall; though in good weather a num-

ber of wagons for a length of time, and over an unusually good road, were observed to haul one and one-third perches per load, and in one instance where the road was in fine order, although it was hilly, a team of four horses, *without aid upon the ascents,* hauled thirty-six cubic feet of limestone, at one load, the distance of the haulage being $1\frac{1}{10}$ miles.

To the haulage then, of such materials as compact limestone, or those which may not essentially differ from it in weight, our formulæ as they stand are particularly designed to apply; though by altering the load as before suggested for another purpose, it will be found of useful application to stones of different specific gravity.

The time lost in loading, unloading, waiting at the quarry, and all other lost time per load, was found by a number of trials to average nearly thirty minutes or five-tenths of an hour.

When the full daily wages of hands was \$1.25, and the quarry crane was wrought by a horse worth seventy-five cents per day, the cost of loading a wagon with a perch of stone, by using a common crane at the quarry, and unloading it by hand at the work, *taken together* averaged twenty-five cents per perch, which is the assumed constant charge for these items per load, which we have embodied in the formulæ.

Notation.

$n.$ = *The number of hours wrought per day* by each wagon, which may, upon an average, be considered as ten hours.

$h.$ = *The haul in miles,* or distance of the quarry from the work.

$d.$ = *The daily wages in cents of a four horse wagon,* including the driver and all other charges per day.

$x.$ = *The number of loads hauled per day* by each wagon, each load of stone being assumed to make *one perch of wall.*

$y.$ = *The cost in cents per perch of wall,* of hauling stone any given distance.

Then the formula to find x, the number of loads hauled per day, will in its first form be,

$$\left(\frac{1}{\frac{h}{1.1}+0.5}\right)n = x$$

Substituting 10 for n, transforming and reducing, we have,

$$\left(\frac{1}{\frac{h}{1.1}+0.5}\right)10 = \frac{10}{\frac{h+0.55}{1.1}} = \frac{11}{h+0.55} = x \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad \text{I.}$$

And the formula to find y, the cost of hauling per perch, will be.

$$\frac{d+0.25}{x} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{II.}$$

When x is found by the formula I, if it has decimals annexed, the nearest *quarter load* to it must be assumed as the true value of x, and used to find y in formula II, because this is the smallest fraction of a load which can be made available in practice, for as a general rule the wagons will stop at night, either at the quarry or at the work; then by driving a little later upon alternate days, an average half load may sometimes be hauled; for instance, in a certain case which occurs to the mind of the writer, three and a half loads were made one day, three loads the next, three and a half the next, &c., thus averaging per day three and a quarter loads, which is not an uncommon case.

Though the number of experiments, and the variety of the circumstances, from which the foundation data of our formulæ were deduced, have not been as numerous as the writer desired, and therefore, though cases may occur where the equations will need corrective quantities, still as they have been found to correspond in their results with sufficient accuracy to actual practice, in hauling the stone, *for some thousands of perches of masonry,* in a series of cases which came under the notice of the writer, he offers them to professional men as at least a better means of determining the value of this element of the cost of constructions of stone, than the mere judgment unaided by calculation, and as some evidence of this, the following statement of calculated and actual results is offered.

Results of the Formulæ compared with Practice.

1.	2.	3.	4.	5.	6.	7.	8.
No. of work at which experiments were tried.	Length of haul in miles.	Loads of one perch hauled in a day of 10 hours, by formula I.	Nearest quarter load to the results of col. 3.	No. of loads actually hauled per day.	Cost per perch in cts. by formula II, assuming the results of col. 4 to $=x$.	Calculated cost using the actual number of loads hauled per col. 5 for x.	Calculated cost in cts. per perch per mile using the numbers of col. 4 as $=x$.
1	$1\frac{10}{100}$	$6\frac{6}{10}$	$6\frac{1}{2}$	$6\frac{1}{2}$	81	81	73
2	$1\frac{70}{100}$	$4\frac{9}{10}$	5	5	105	105	62
3	$1\frac{76}{100}$	$4\frac{9}{10}$	5	5	105	105	60
4	2	$4\frac{1}{3}$	$4\frac{1}{4}$	$4\frac{1}{4}$	124	124	61
5	$2\frac{80}{100}$	$3\frac{3}{10}$	$3\frac{1}{4}$	$3\frac{1}{4}$	162	162	58
6	$3\frac{15}{100}$	3	3	3	175	175	55
7	$3\frac{29}{100}$	$2\frac{9}{10}$	3	3	175	175	53

From the above table, which supposes a team and its driver to cost five dollars per day, it will be perceived that the shortest haul has the greatest cost *per perch per mile;* we are prepared for this result by the reflection, that the additional number of loads consequent upon a shorter haul, increases the quantity of time lost by the teams per day, diminishes consequently the distance actually traveled, and must therefore augment the cost *per perch per mile.*

Computing by formulæ I and II, the maximum haul which a four horse team, upon an average, will perform in a day of ten hours working time, we find it will be near $10\frac{45}{100}$ miles, or $20\frac{9}{10}$ miles lineal traveled per day; and over this distance of $10\frac{45}{100}$ miles, from the quarry to the work, the wagon would daily transport *one perch of stone, or deliver a load a day,* which, putting the team and driver at five dollars per day, and allowing twenty-five cents per perch for loading and unloading, would cost fifty cents per perch per mile of the maximum daily haul; whilst on the other hand, if the quarry were but a mile from the work, the number of loads delivered per day, would be $7\frac{1}{10}$ (say seven) and the cost per perch per mile of haul, would amount to seventy-five cents nearly, including in every case the expense of loading at the quarry, and also of unloading at the work.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Peter Von Smith's Plan for a Railroad.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the plan for a Railroad, invented by Mr. Peter Von Smith of Washington, D. C., Report:

That they have examined the working model and explanatory drawings prepared by the inventor. The peculiarities of this plan may be briefly stated to consist of

I. The adoption of a single rail, supported by a line of upright posts, and elevated a few feet above the surface of the ground. This rail is to be traversed by cars formed of two boxes, which are suspended from the axles of wheels rolling on the rail, the equilibrium being preserved by keeping the centre of gravity of the boxes below the point of suspension.

II. The use of two tracks, (each track consisting of a single rail) having opposite inclinations, along which the cars descend by virtue

of the force of gravity. In the model exhibited, this was the only power employed for the production and maintenance of motion; though the Committee were informed by the inventor, that each car will be provided with a peculiar arrangement, by means of which an adequate force for the preservation of its momentum may be constantly or occasionally developed. But no explanation was offered of the character of this extra power.

III. The introduction of locks, or vertical lifts, at convenient points along the line of the road, for the purpose of raising the cars from the low level to which they are brought by the descending grade, to the summit of the grade along which they are next to descend. The whole line being thus divided into a succession of vertical lifts, through which the cars are elevated by the direct application of a peculiar power, and of uniform grades, through which they descend by the force of gravity.

IV. The employment of the buoyant property of atmospheric air, confined under water, as the means of lifting the cars from the lower to the higher levels. To produce this effect by the arrangements explained to the Committee, there are required a head of water somewhat greater than the height of the lift of the lock; three or more tanks for the condensation of the air, and another tank, or lock, containing a column of water exceeding, by a few feet, the lift of the lock. A framing of timber is inserted in this vessel, bearing on its summit a rail corresponding with that of the lower railroad, and resting on an inverted receiver, which is placed over the orifices of tubes communicating with a vessel containing the condensed air. The density of the air is that which is due to the head of water at command, unless the machinery to work a condensing pump be added to the arrangement.

The cars descending the railroad are brought to rest on the summit of the timber framing immersed in the tank; and by striking a key as they reach their position, liberate the confined air in the condensor, which is discharged into the receiver until the water displaced is equal to the weight to be raised. The buoyant force of the air lifts the frame supporting the car, to the level of the upper track; when the inclined position of the rail permits the car again to be put in motion, and the movement is continued until it reaches the succeeding lock. In this operation the quantity of water consumed in the condensation of the air, is the same as would be required to lift the car directly without the employment of the air; but it is the opinion of the inventor that though it might frequently be difficult to obtain the requisite head and quantity of water at the points where it would be convenient to establish the locks, the condensed air could always be conveyed by

pipes from considerable distances. The execution of such a road would consequently render long lines of pipes indispensable; and the power of the stream would have to be sufficient to overcome the weight of the car and its framing, and the friction of the air in its passage through the pipes.

It is not deemed at all necessary to notice the various contrivances which the author has devised for the condensation and control of the air, and the discharge of the water when the tanks need replenishing, so as to keep up the operation of the machinery of the station—details which can be much more satisfactorily comprehended by inspecting the very ingenious model shown to the Committee. It is thought preferable to confine their examination to the principal features of the plan, with a view to the expression of an opinion of its merits as a competent substitute for the present system of railroad conveyance.

The single rail is not essential to the particular plan before the Committee; and as a road, in all respects similar, was patented in this country by Col. Sergeant many years since, and in England by a Mr. Palmer more recently, the latter of which has been frequently described by the patentee and other professional writers, the merit of this part of the present plan need not now be particularly discussed. A road with a single rail, though exposed to very obvious and serious objections, may possibly possess advantages which will yet authorize the introduction of the method for certain situations. But these advantages, whatever they be, have not yet been acknowledged; and the invention of Mr. Von Smith must therefore be considered independently of this feature.

This part of the plan being withdrawn from the arrangement proposed, the only peculiarities of the method will consist in the use of two roads in all cases; and the substitution of descending uniform grades, with frequent vertical lifts, in place of the undulations and locomotive power employed on other lines.

The practicability of carrying on the ordinary business of a line by such an arrangement will not be questioned, whatever be the nature of the power employed for the vertical lifts; but at the same time the plan appears to be liable to some formidable objections, which it is essential to notice.

In most cases, in this country, a single track is sufficient for the accommodation of all the trade which the work can command; and of course the expense of constructing and maintaining two lines to perform the duty which could be accomplished by one, must be regarded as a very serious item in the comparison of the two systems.

If the cars be forwarded in trains, the expense of constructing and keeping in repair locks of thirty feet lift, adequate to their simultaneous

elevation, would be very great; and if sent singly, the expense of transportation would be seriously augmented by the necessity of employing an agent to accompany each car.

The consumption of time at the locks incident to the system, would also essentially impair its value; and, in the opinion of the Committee, would probably amount to a sufficient inconvenience to constitute an insuperable obstacle to its adoption.

On ordinary well constructed railroads the progress of the cars would not be depended on, in calm weather, if the grade were less than twenty-one or twenty-two feet per mile. And to give an impulse sufficient to generate the velocity intended to be maintained throughout the grade—say sixteen miles per hour—would require an additional fall, immediately at the lock, of at least nine feet. If the maximum lift of the locks be limited to thirty feet, as is proposed, there would be needed, on level ground, and in calm weather, at least one lock in every mile—and a greater number in ascending grades.

It is true that some few feet of lockage might be saved in reducing the momentum of the car at the end of the grade; but, on the other hand, any such saving would be needed to overcome the occasional resistance from head winds, which has not been allowed for in the above estimate of the number of stations. Indeed, the inclination of the grade, even in calm weather, ought to exceed the amount necessary to overcome the resistance; for, if the momentum were, from any cause, destroyed between the stations, it could not otherwise be communicated to the cars, but by resorting to that reserved power suggested, but not explained, to the Committee.

It should be observed that the inventor proposes to reduce the number of lockages, and consequent delay, by diminishing the resistance at the axles of the cars, through the agency of the friction wheels; and to lessen the cost of construction, by the use of the single rail. But as no particular plan was exhibited to the Committee for obviating the objections to a multiplication of such wheels, they do not feel authorized to anticipate a more successful result on this occasion, than has been experienced in former attempts to apply the same principle to the railroad car; and they are not aware of any facts which would serve as the basis of an estimate of the ultimate expense of the single rail, and justify the expectation of any reduction of cost in consequence of its adoption.

In consideration of the objections enumerated, the Committee cannot recommend the plan submitted to their inspection, as a proper or useful substitute for the railroad and motive power which the public judgment has adopted. And as this conclusion is independent of the

cost of power employed at the stations, they have not regarded it as incumbent on them to enter into any investigation of the comparative merits of condensed air as a lifter, operating by virtue of its buoyant force, and of the immediate application of the power used for the condensation of the air, to the same purpose. This and other subordinate questions are superseded by those radical and essential features of the system, to which they have already adverted. But while they do not regard the plan as suitable for the great purposes subserved by the railroad system, they cannot but commend the mechanical ingenuity displayed in the model exhibited by the inventor.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, May 11th, 1841.

Report on Mr. John Wier's Window Blind.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Window Blind constructed by Mr. John Wier, of the city of New York, Report:

That the window blind submitted to their examination differs from the common blind chiefly in the mode of suspension, which (instead of using pulleys inserted in a mortise, or cut, in the head board) is effected by means of a horizontal roller, as long as the width of the blind, passing across beneath the head board, around which are wound the cords passing through each of the blinds. On one end of this roller is a ratchet wheel with a click, or catch,—so that the blind can be raised to the desired height, and there remains fixed without the trouble of winding the cord around pins in the window frame. If it is desired to lower the blind, a check string attached to the catch is pulled, and the roller, with a reverse motion, allows the blind to descend. By this arrangement several defects and inconveniences in the common blind are entirely removed. The blinds always preserve their proper level, or horizontal position, in being raised or lowered, which is frequently not the case when acted upon in the common mode of suspension by two cords passing over pulleys.

The wearing and chafing of the cords consequent upon friction is also avoided, and the disagreeable creaking noise made in raising and lowering the common blind is not heard in this. The mode of changing the position, or inclination, of the blinds, so as to admit or exclude the light, appears also to be an improvement upon the common method.

In conclusion, the Committee would remark generally that they view Mr. Wier's window blind as a decided improvement upon that

useful and almost indispensable article of household furniture, and they understand that it can be afforded at about the same price as the common blind. Having thus the double advantage of utility and economy, they consider it worthy the attention of upholsterers and housekeepers in general.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, October 14, 1841.

Report on John L. Clarke's Brake for Railroad Cars.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the plan for a Brake for Railroad Cars constructed by John L. Clarke, Esq., of Nashua, New Hampshire, Report:

That they have examined the very neat model of the invention of Mr. Clarke, the peculiarities of which are accurately set forth in his description of its purpose and arrangement—viz: "a simple piece of machinery, the object of which is to apply the momentum of the train at the pleasure of the engine man, to the friction brakes, and thereby arrest the progress of the cars. To effect this, under each car, and in the centre, there is a strong rod, of even length with the buffing beams, and so adjusted in bearings as to move freely a given distance, either way, lengthways of the car. Upon this rod are collars and a double set of progressive levers, or toggles, so arranged that when the rod is moved either way the collars will act upon one of the toggles, and this toggle acting upon another lever the brakes are applied to the wheels. There being a continuous line of rods through the whole train, and the rods being the same length with the buffing beams, it is evident that when the rods are at rest the buffers of the cars will come in contact, and the brakes will not be applied. But the rod under the tender is so adjusted that the engine man, by a lever, can at pleasure throw it back, and thus apply the brakes to the tender. The rear end of the tender rod, of course, throws back the rod on the car behind and applies the brakes on that car, and so on through the train.

This arrangement will, of course, dispense with several brakemen, and in any sudden emergency enables the engine man to stop the whole train, in the shortest possible time by simply moving a lever; for the rod under the tender being first thrown back, and its brakes applied, the cars behind, as they successively come up, apply their own brakes by their own momentum till the whole train is at rest."

It may be added to this description that the rod which operates on

the brakes of the tender is provided with a peculiar catch to enable the engine man first to throw the rod back so that its rear end may protrude beyond the buffers, and that the pressure of the rod of the car immediately behind it may bring the brake of the tender upon the tender wheels until considerable friction is there obtained; and an equal amount of friction at the wheels of the cars by the reaction of the tender rod upon the rods of the cars. The Committee do not doubt the efficiency of this machinery, if well constructed, in checking the progress of the train, and they are disposed to anticipate its successful application on a larger scale with much confidence. But yet there are some questionable points which compel them to reserve their entire approbation, until the efficiency of the contrivance has been tested in practice. The influence of the wear and tear, to which the rods and levers will be exposed, in deranging the machinery and unfitting it for action has yet to be ascertained by experiment; and though the model does seem to promise well in these particulars, they do not think it prudent further to commend the plan until experience has afforded better data than they now possess. On the whole they deem the invention worthy of trial by railroad companies.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, November 11th, 1841.

Report on Mr. Joseph Saxton's Reflecting Pyrometer.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Reflecting Pyrometer, invented by Mr. Joseph Saxton of Philadelphia, Pennsylvania, Report:

That this instrument shows and measures, in a peculiar and advantageous manner, the linear expansion of a metallic or other rod subjected to the influence of heat. The rod rests against a fixed support, at one end; the other end of it presses against a sliding bar which carries an arm attached to one end of a fusee chain of a watch. This chain is wound around an axle carrying a mirror; and the other end of the chain is fastened to a spring, to preserve its tension. Hence as the rod under trial expands, and the sliding bar moves, the axle and mirror revolve; and if a sunbeam, thrown upon this mirror in a proper position, be reflected from it upon a distant wall, the angular motion of the reflected image will be twice that of the axle, and will serve to measure the amount of expansion. As the sun is also in motion, a fixed mirror, near the revolving one, is made to reflect another beam, at first coinciding with the former one: and as the latter

beam moves only with the sun, the angular distance between the two reflected beams, or images, will be twice the angular motion of the axle.

This instrument is especially valuable for the trial of compensating pendulums, as has been proved by Mr. Saxton. For this purpose the pendulum was enclosed in a hollow cylinder, in order that hot or cold water might be used for varying the temperature. The cylinder was supported vertically in a proper wooden frame; and the lower end of the pendulum, passing through a cork tightly closing the lower end of the cylinder, was adjusted to the sliding bar beneath it, which pressed firmly upward against the pendulum, by the action of a spring. By this arrangement the revolving mirror was found always to return to its first position, when slightly moved by the hand; thus showing the delicacy of the mechanism: and the pendulum was considered perfect when a change of its temperature caused no motion of the revolving mirror.

The committee deem this invention of Mr. Saxton's so useful and ingenious, that they recommend the award of a Scott's Legacy Medal and Premium, as a slight recognition of this service in the cause of science and the useful arts.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, November 11, 1841.

Progress of Practical & Theoretical Mechanics & Chemistry.

Calotype.

The following account of some recent improvements in photography, by H. F. Talbot, Esq., was lately read before the Royal Society.

The author had originally intended, in giving an account of his recent experiment in photography, to have entered into numerous details with respect to the phenomena observed; but finding that to follow out this plan would occupy a considerable time, he has thought that it would be best to put the Society, in the first place, in possession of the principal facts, and by so doing perhaps invite new observers into the field during the present favourable season for making experiments. He has, therefore, confined himself at present to a description of the improved photographic method, to which he has given the name of *Calotype,* and reserves for another occasion all remarks on the theory of the process. The following is the method of obtaining the Calotype pictures.

Preparation of the Paper.—Take a sheet of the best writing paper, having a smooth surface and a close and even texture. The water

mark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystalized nitrate of silver in six ounces of distilled water. Wash the paper with this solution, with a soft brush, on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distant fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in this solution. Then dip it into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it even if held pretty near; or else it may be left to dry spontaneously. All this is best done in the evening by candle light. The paper so far prepared the author calls *iodized paper,* because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but, nevertheless, it ought to be kept in a portfolio or a drawer, until wanted for use. It may be kept for any length of time without spoiling or undergoing any change, if protected from the light. This is the first part of the preparation of Calotype paper, and may be performed at any time. The remaining part is best deferred until shortly before the paper is wanted for use. When that time is arrived, take a sheet of the iodized paper and wash it with a liquid prepared in the following manner:—Dissolve 100 grains of crystalized nitrate of silver in two ounces of distilled water; add to this solution one-sixth of its volume of strong acetic acid. Let this mixture be called A. Make a saturated solution of crystalized gallic acid in cold distilled water. The quantity dissolved is very small. Call this solution B. When a sheet of paper is wanted for use, mix together the liquids A and B in equal volumes, but only mix a small quantity of them at a time, because the mixture does not keep long without spoiling. I shall call this mixture the *gallo-nitrate of silver.* Then take a sheet of iodized paper and wash it over with this gallo-nitrate of silver, with a soft brush, taking care to wash it on the side which has been previously marked. This operation should be performed by candle-light. Let the paper rest half a minute, and then dip it into water. Then dry it lightly with blotting paper, and finally dry it cautiously at a fire, holding it at a considerable distance therefrom. When dry, the paper is fit for use. The author has named the paper thus prepared *calotype paper,* on account of its great utility in obtaining the pictures of objects with the camera obscura. If this paper be kept in a press it will often retain its qualities in perfection for three months or more, being ready for use at any moment; but this is not uniformly the case, and the author therefore recommends that it should be used in a few hours after it has been prepared. If it is used immediately, the last drying may be dispensed with, and the paper may be used moist. Instead of employing a solution of crystalized gallic acid for the liquid B, the tincture of galls diluted with water may be used, but he does not think the results are altogether so satisfactory.

Use of the Paper.—The calotype paper is sensitive to light in an extraordinary degree, which transcends a hundred times, or more, that of any kind of photographic paper hitherto described. This may be

made manifest by the following experiment:—Take a piece of this paper, and having covered half of it, expose the other half to daylight for the space of *one second* in dark cloudy weather in winter. This brief moment suffices to produce a strong impression upon the paper. But the impression is latent and invisible, and its existence would not be suspected by any one who was not forewarned of it by previous experiments. The method of causing the impressions to become visible is extremely simple. It consists in washing the paper once more with the gallo-nitrate of silver prepared in the way above described, and then warming it gently before the fire. In a few seconds the part of the paper upon which the light has acted begins to darken, and finally grows entirely black, while the other part of the paper retains its whiteness. Even a weaker impression than this may be brought out by repeating the wash of gallo-nitrate of silver, and again warming the paper. On the other hand, a stronger impression does not require the warming of the paper, for a wash of the gallo-nitrate suffices to make it visible, without heat, in the course of a minute or two. A very remarkable proof of the sensitiveness of the calotype paper is afforded by the fact stated by the author, that it will take an impression from simple moonlight, not concentrated by a lens. If a leaf is laid upon a sheet of the paper, an image of it may be obtained in this way in from a quarter to half an hour. This paper being possessed of so high a degree of sensitiveness, is therefore well suited to receive images in the camera obscura. If the aperture of the object-lens is one inch, and the focal length fifteen inches, the author finds that *one minute* is amply sufficient in summer to impress a strong image upon the paper of any building upon which the sun is shining. When the aperture amounts to one-third of the focal length, and the object is very white, as a plaster bust, &c., it appears to him that *one second* is sufficient to obtain a pretty good image of it. The images thus received upon the Calotype paper are for the most part invisible impressions. They may be made visible by the process already related, namely, by washing them with the gallo-nitrate of silver, and then warming the paper. When the paper is quite blank, as is generally the case, it is a highly curious and beautiful phenomenon to see the spontaneous commencement of the picture, first tracing out the stronger outlines, and then gradually filling up all the numerous and complicated details. The artist should watch the picture as it developes itself, and when in his judgment it has attained the greatest degree of strength and clearness, he should stop further progress by washing it with the fixing liquid.

The fixing process.—To fix the picture, it should be first washed with water, then lightly dried with blotting paper, and then washed with a solution of bromide of potassium, containing 100 grains of that salt dissolved in eight or ten ounces of water. After a minute or two it should be again dipped in water and then finally dried. The picture is in this manner very strongly fixed, and with this great advantage, that it remains transparent, and that, therefore, there is no difficulty in obtaining a copy from it. The calotype picture is a negative one, in which the lights of nature are represented by shades; but

the copies are positive, having the lights conformable to nature. They also represent the objects in their natural position with respect to right and left. The copies may be made upon Calotype paper in a very short time, the invisible impressions being brought out in the way already described. But the author prefers to make the copies upon photographic paper prepared in the way which he originally described in a memoir read to the Royal Society in February, 1839, and which is made by washing the best writing paper, first with a weak solution of common salt, and next with a solution of nitrate of silver. Although it takes a much longer time to obtain a copy upon this paper, yet, when obtained, the tints appear more harmonious and pleasing to the eye; it requires in general from three minutes to thirty minutes of sunshine, according to circumstances, to obtain a good copy on this sort of photographic paper. The copy should be washed and dried, and the fixing process (which may be deferred to a subsequent day) is the same as that already mentioned. The copies are made by placing the picture upon the photographic paper, with a board below and a sheet of glass above, and pressing the papers into close contact by means of screws or otherwise. After a calotype picture has furnished several copies, it sometimes grows faint, and no more good copies can then be made from it. But these pictures possess the beautiful and extraordinary property of being susceptible of revival. In order to revive them and restore their original appearance, it is only necessary to wash them again by candle-light with gallo-nitrate of silver, and warm them; this causes all the shades of the picture to darken greatly, while the white parts remain unaffected. The shaded parts of the picture thus acquire an opacity which gives a renewed spirit and life to the copies, of which a second series may now be taken, extending often to a very considerable number. In reviving the picture it sometimes happens that various details make their appearance which had not before been seen, having been latent all the time, yet nevertheless not destroyed by their long exposure to sunshine. The author terminates these observations by stating a few experiments calculated to render the mode of action of the sensitive paper more familiar. 1. Wash a piece of the iodized paper with the gallo-nitrate; expose it to daylight for a second or two, and then withdraw it. The paper will soon begin to darken spontaneously, and will grow quite black. 2. The same as before, but let the paper be warmed. The blackening will be more rapid in consequence of the warmth. 3. Put a large drop of the gallo-nitrate on one part of the paper, and moisten another part of it more sparingly, then leave it exposed to a very faint daylight; it will be found that the lesser quantity produces the greater effect in darkening the paper; and in general, it will be seen that the most rapid darkening takes place at the moment when the paper becomes nearly dry; also, if only a portion of the paper is moistened, it will be observed that the edges or boundaries of the moistened part are more acted on by light than any other part of the surface. 4. If the paper, after being moistened with the gallo-nitrate, is washed with water and dried, a slight exposure to daylight no longer suffices to produce so much discoloration; in-

deed it often produces none at all. But by subsequently washing it again with the gallo-nitrate and warming it, the same degree of discoloration is developed as in the other case (experiments 1 and 2.) The dry paper appears, therefore, to be equal, or superior, in sensitiveness to the moist; only with this difference, that it receives a virtual instead of an actual impression from the light, which it requires a subsequent process to develop. Civ. Eng. & Arch. Jour., August, 1841.

Report of a Chemical Examination of twenty-four pieces of Corahs, from Calcutta, many of which were more or less damaged by mildew. By ANDREW URE, M. D., F. R. S., Prof. of Chemistry.

These pieces of silk were put into my hands, for analysis, on the 18th of February, after I had, on the preceding 12th of the month, visited the St. Katharine's Dock Warehouse, in New Street, Bishopsgate Street, for the purpose of inspecting a large package of the Corahs, per Colonist. I was convinced, by this inspection, that, notwithstanding the apparent pains bestowed upon the tin plate and teak wood packing cases, certain fissures existed in them, through which the atmospheric air had found access, and had caused iron-mould spots upon the gummy wrapper, from the rusting or oxidizement of the tinned iron.

I commenced my course of analysis upon some of the pieces which were most damaged, as I thought they were most likely to lead me to an exact appreciation of the cause of the mischief; and I pursued the following general train of researches:—

1. The piece of silk, measuring from six to seven yards, was freely exposed to the air, then weighed, afterwards dried near a fire, and weighed again, in order to determine its hygrometric property, or its quality of becoming damp by absorbing atmospheric vapour. Many of the pieces absorbed, in this way, from one-tenth to one-eighth of their whole weight; that is, from one ounce to one ounce and a half upon thirteen ounces. This fact is very instructive, and shows that the goods had been dressed in the loom, or imbued subsequently with some very deliquescent, pasty matter.

2. I next subjected the piece to the action of distilled water, at a boiling temperature, till the whole glutinous matter was extracted; five pints of water were employed for this purpose, the fifth being used in rinsing out the residuum. The liquid wrung out from the silk was evaporated first over the fire, and towards the end over a steam bath, till it became a dry extract; which, in the damaged pieces, was black, like extract of liquorice, but in the sound pieces was brown. In all cases, the extract so obtained, absorbed moisture with great avidity. The extract was weighed in its driest state, and the weight noted, which shewed the addition made, by the dressing, to the weight of the silk. The piece of silk was occasionally weighed in its cleansed state, when dry, as a check upon the preceding experiment.

3. The dry extract was now subjected to a regular chemical analysis, which was modified according to circumstances, as follows:—100

parts of it were carefully ignited in a platinum capsule; during which a considerable flame and fetid smoke were disengaged. The ashes, or incombustible residuum, were examined by the action of distilled water, filtration, as also by that of acids, and other chemical tests, whereby the constituents of these ashes were ascertained. In the course of the incineration or calcination of the extract from the several samples, I never observed any sparkling or scintillation; whence I observed that no nitre had been used in the dressing of the goods, as some persons suggested.

4. Having, in the course of boiling some of the extract from two of the damaged pieces, in a little distilled water, smelt a urinous odour, I was induced to institute the following minute course of researches, in order to discover whether the urine of man had been introduced into the dressing paste of the silk webs. I digested a certain portion of the said extract in alcohol, sixty per cent. over proof, which is incapable of dissolving the rice water, or other starchy matter, which might be properly applied to the silk in the loom. The alcohol, however, especially when aided by a moderate heat, readily dissolves urea, a substance of a peculiar nature, which is the characteristic constituent of human urine. The alcohol took a yellow tint, and being, after subsidence of the sediment, decanted clear off into a glass retort, and exposed to the gentle heat of a water bath, it distilled over clear into the receiver, and left a residuum in the retort, which possessed the properties of urea. This substance was solid when cold, but melted at a heat of 220° Fahr.; and at a heat of about 245° it decomposed with the production of water and carbonate of ammonia,—the well known products of urea at that temperature. The exhalation of the ammonia was very sensible to the smell, and was made peculiarly manifest by its browning yellow turmeric paper, exposed in a moist state to the fumes, as they issued from the orifice of the glass tube, in which the decomposition was usually effected. I thus obtained perfect evidence that urine had been employed in India in preparing the paste with which a great many of the pieces had been dressed. It is known to every experienced chemist, that one of the most fermentative or putrefactive compositions which can be made, results from the mixture of human urine with starchy or gummy matter, such as rice water; a substance which, by the test of iodine water, these Corahs also contained, as I shewed to the gentlemen present, at my visit to the Bonding Warehouse.

5. On incinerating the extracts of the Corahs, I obtained, in the residuum, a notable quantity of free alkali; which, by the test of chloride of platinum, proved to be potassa. But, as the extract itself was neutral to the tests of litmus and turmeric paper, I was consequently led to infer, that the said extract contained some vegetable acid, probably produced by the fermentation of the weaver's dressing, in the hot climate of Hindostan. I, accordingly, examined the nature of this acid, by distilling a portion of the extract along with some very dilute sulphuric acid, and obtained, in the receiver, a notable quantity of the volatilized acid condensed. This acid might be the acetic (vinegar,) the result of fermentation, or it might be the formic or acid of

ants, the result of the action of sulphuric acid upon starchy matter. To decide this point, I saturated the said distilled acid with magnesia, and obtained on evaporation, the characteristic gummy mass of acetate of magnesia, soluble in alcohol, but none of the crystals of formiate of magnesia, insoluble in alcohol. From the quantity of alkali (potassa) which I obtained from the incineration of the extract of one piece of the damaged silk, and which amounted to six grains at least, I was convinced that wood ashes had been added, in India, to the mixture of sour rice water and urine, which would therefore constitute a compound remarkably hygrometric, and well qualified to keep the warp of the web damp, even in that arid atmosphere, during the time that the Tanty, or weaver, was working upon it. The acetate of potassa, present in the said Corahs, is one of the most deliquescent salts known to the chemist; and, when mixed with fermented urine, forms a most active hygrometric dressing,—one, likewise, which will generate mildew upon woven goods, with the aid of heat and the smallest portion of atmospheric oxygen. By the above mentioned fermentative action, the carbon, which is one of the chemical constitutents of the rice or starchy matter, had been eliminated, so as to occasion the dark stains upon the silk, and the blackness of the extract taken out of it by distilled water.

6. That the dressing applied to the webs is not simply a decoction of rice, becomes very manifest, by comparing the incinerated residuum of rice with the incinerated residuum of the extract of the said Corahs. I find that 100 grains of rice, incinerated in a platinum capsule, leave only about one-fifth of a part, or 1 in 500 of incombustible matter, which is chiefly siliceous sand; whereas, when 100 grains of an average extract of several of these Corahs were similarly incinerated, they left fully seventeen parts of incombustible matter. This consisted chiefly of alumina or earth of clay, with silica, potassa, and a little common or culinary salt. (Has the clay been added, as is done in Manchester, to give apparent substance to the thin silk web?)

From the above elaborate course of experiments, which occupied me almost constantly during a period of four weeks, I was fully warranted to conclude that the damage of said goods had been occasioned by the vile dressing which had been put into them in India; which as I have said, under the influence of heat and air, had caused them to become more or less mildewed, in proportion to their original dampness when packed at Calcutta, or to the accidental ingress of atmospheric air into the cases during the voyage from Calcutta to London.

Having in the preceding report demonstrated, by the clearest processes of chemical research, that the above mildewed Corahs had been damaged by the fermentative decomposition of the dressing paste with which they had been so abundantly impregnated, I would recommend the importers of such goods to cause the whole of the dressing to be washed out of them, and the pieces to be thoroughly dried before being packed up. I believe that clean silk may be kept and transported, even in the most humid atmosphere, without undergoing any change, if it be not imbued with fermentative paste.

Lond. Jour. Arts & Sci., July, 1841.

On the circumstances under which the Explosions of Steam Boilers generally occur, and on the means of preventing them. By Dr. Schafhaeutl, of Munich.

In this communication it is assumed, that perhaps not one-tenth of the recorded explosions of steam boilers can be correctly attributed to the over loading of the safety valve, or to the accumulation of too great a quantity of steam in the boiler. The author alludes to the degree of pressure which hollow vessels, even of glass, are capable of sustaining, if the pressure be applied gradually. He found, in repeating the experiments of Cagniard de la Tour, subjecting glass tubes of one or two inches in length, one-fourth part filled with water, hermetically sealed, and immersed in a bath of melted zinc, that they apparently sustained the immense pressure of four hundred atmospheres, without bursting; but if the end of an iron rod was slightly pressed against the extremity of the tube, and the rod caused to vibrate longitudinally by rubbing it with a leather glove covered with resin, the tube was invariably shattered to pieces. Hence he concludes, that something more than the simple excess of pressure of steam in the boiler is necessary to cause an explosion, and that a slight vibratory motion alone, communicated suddenly, or at intervals, to the boiler itself, might cause an explosion. From the circumstance of safety valves having been generally found inefficient, he concludes that a force has operated at the instant it was generated in tearing the bottom or sides of the boiler, before it could act upon the safety valve. From the sudden effect of this force, explosions have been ascribed to the presence of hydrogen, generated by the decomposition of water; but independently of the difficulty of generating a large quantity of hydrogen in such a manner, it could neither burn nor explode without the presence of a certain quantity of free oxygen, or atmospheric air; and such an explosive mixture would not take fire, even if mixed with 0.7 of its own volume of steam. The ordinary mode of converting water into steam is by successively adding small portions of caloric to a relatively large body of liquid; but if the operation was reversed, and all the heat imparted to a given quantity of water in one unit of time, an explosive force would be developed at the same moment. For example, if a bar of iron be heated until it is coated with liquid slag, and is then laid upon a globule of water on an anvil, and struck with a hammer, the liquid slag communicates its caloric instantly to the water, becoming solid at the same time that the water is converted into vapour with a loud report. A similar occurrence may take place in a steam boiler when a quantity of water is thrown into contact with an overheated plate, either by a motion of the vessel, or from a portion of the incrustation formed on the bottom or sides becoming loosened. A sudden opening of the safety valve may, under certain circumstances, prove dangerous, or even any rapid increase of heat which would cause a violent excess of ebullition in the water. An examination is then entered into of the respective powers of water and of steam, to transmit undulatory motion, and of their compressibility.

According to Laplace, the conducting power of steam at our atmosphere and 294.1° Fah. is 1041.34511 feet per second, and that of water 6036.88 feet. The ratio of these different velocities is therefore as 1 : 4.5. In cases of a sudden explosive development of steam, the principal action is directed against the bottom, or the sides, of the boiler, whence spreading itself through the water it is finally transmitted through the steam to the safety valve: a wave created by an explosion, even at the surface of the water, would reach the bottom or the sides of the boiler, four and a half times sooner than it would effect the top of the steam chamber: but if it took place at the bottom, the time for the explosive wave to reach the safety valve would be the sum instead of the difference of both velocities. Although these relative periods of time may be considered as infinitely small, it is contended that there is sufficient delay (counting from the moment at which the plates begin to yield) to cause the rupture of the material, which would otherwise have yielded by its own elasticity had the time been greater, as all communication of motion is dependent only on time. To illustrate the effect of the sudden development of an explosive force upon the plates of a boiler, the author gives the results of a series of experiments made by him upon iron wires, for the purpose of ascertaining the amount of elongation which took place before yielding under the sudden application of a given weight. The result was, that a wire which had resisted a tension of 22 cwt. when gradually applied, broke invariably, without any elongation, when the same force was suddenly applied by a falling body. Similar experiments with railway bars showed that fibrous iron, which supported a gradual tension, broke by the sudden application of the same force; while close-grained iron, which was incapable of resisting the gradual strain, bore perfectly well that of sudden impact. These facts are worthy of consideration in the selection of iron for boiler plates, where the sudden action of the rending force is to be guarded against. The details are then given of a series of experiments, illustrating in an ingenious model, by means of an explosive mixture of chlorate of potassa, the effects of explosions at different heights within a boiler. A careful examination of the circumstances, and the results of his experiments, convinced the author that a simple mechanical arrangement, applicable to all boilers, might be introduced, so as to diminish the danger arising from the sudden development of an explosive force. He proposes to connect with the bottom of the boiler, by means of a pipe, an extra safety valve of a given area, loaded to five-sixths of the absolute cohesive force of the boiler plate. In the event of a sudden development of steam, the first shock would act upon the valve and open it, which would have the effect of depriving the wave generated of its destructive force, and at the same time diminish the violence of the second shock from the top of the boiler, having permitted the escape of a portion of the water from the boiler.

Lond. Athenæum, Sept. 1841.

Improvement in the Manufacture of Iron. Report of the Furnaces and Stoves of the Manufactory of Wasseralfingen, worked by Gas. By R. H. Schoenberg.

When we endeavour to include in one *coup d'œil* the progress that has hitherto been made in the manufacture of iron, we feel great satisfaction in reflecting on the success which this important branch of industry has attained, and the wonderful effects which have resulted from the aid it has received from science since the commencement of the present century. The numerous efforts that have been made by the iron-masters, and the proprietors of iron foundries, to diminish the expenses of manufacture, by economy in the materials, are remarkable; and most particularly the attempts of every description that have been made to economize fuel.

It is with reference to this object that in blast-furnaces, and in refinery stoves, successive trials have been made of charcoal, coke, of charred wood, coal, and even of anthracite and turf; and that a new mode has thus been introduced of removing the difficulties consequent to the manufacture, and of diminishing the expenses which attend its production. Subsequently were introduced, the application of heated air, the application of the flame from the mouth of the chimney of blast-furnaces to various purposes, and an infinity of other valuable inventions.

The most important of all these improvements is, perhaps, the one for which we are indebted to M. de Faber, director of the iron manufactories of Wasseralfingen, in Wurtemberg, who has been successful in his attempts to collect before it issues from the mouth of the chimney, the gas which is generated in blast furnaces, and which forms the flame that thus escapes, and of applying it as a combustible in refinery stoves, and in puddling and reverberatory furnaces.

The application of the flame issuing from the mouth of the chimney to different purposes, such as heating the air to be forced into the blast-furnaces, burning lime, roasting the ore, making coke, heating steam-boilers, &c., has been known for seven or eight years; yet in all these cases it has been found impossible to produce with this flame a temperature exceeding red heat, which has imposed limits to this method of application, whilst the method of M. de Faber is calculated to produce the highest temperature that can be required in making iron.

The principal method by which this process is characterized, is the following manner of burning the gas, with the introduction of atmospheric air forced through bellows, and in the ingenious construction of the stoves and furnaces. The conclusions which have been arrived at after many years of experience may, without exaggeration, be considered wonderful, and the discovery to which we allude has introduced a new era in the manufacture of iron quite as remarkable as that for which practical mechanics is indebted to the steam-engine. At Wasseralfingen there are at the present time three furnaces or stoves, worked only by escaped gas, in active operation. It is to the

blast-furnace from the south, introduced into this establishment, that the requisite quantity of gas is extracted for heating a refining-furnace. The application of this method is very simple, and is effected by introducing a tube to a certain depth into the chimney of the blast-furnace. It seems that by this means there is obtained at most one-sixth or a fifth of the total quantity of gas produced, and which escapes from this furnace, and it is certain that, notwithstanding this subtraction, there is scarcely any preceptible diminution in the flame which issues from the mouth of the chimney.

The refining furnace produces about 175 metrical quintals of fine metal weekly, which is always of a beautifully white colour, like silver. The method of refining in this gas furnace is brought to such a high degree of perfection, that the iron always runs from it, in a great degree, decarburetted, and it is freed from all impurities, and, among others, from phosphorus and sulphur. The waste, which in the English refining-furnaces worked by coke is never less than from nine to ten per cent., when the furnace is in good order, never exceeds from one to two per cent. Neither must the circumstance be forgotten that the cast iron passed through the refining-furnace usually only consists of fragments from the foundry, which, as is known, contain a considerable quantity of sand adhering to them from the moulds. The whole operation is so well regulated, and all is conducted with so much uniformity, that there is little liability to those miscalculations and losses which are only too common in the refining furnaces generally used. The expenses of manual labour are also equally small.

The results of puddling with gas, have not been attended with less satisfactory results. The puddling furnace, which has been constructed at Wasseralfingen, and which is in operation there, uses the same gas as the blast-furnaces of the north. In the chimney of this one, two suction pipes are introduced to a suitable depth; by means of these a sufficient quantity of gas can be collected to keep a puddling furnace and a reverberatory furnace in operation at the same time; but the power of the water wheel which puts the bellows in action not being sufficiently great, these furnaces can only be kept in operation alternately.

The temperature of the gas puddling stove is, according to the nature of the process, even higher than that of a similar kind of furnace supplied with wood, coal, or turf. The flame is clear and transparent, so that the workman is enabled to command at a single glance all the points in which it is most active. The operation when properly conducted proceeds with perfect regularity and uniformity. In each of these operations from 1.75 to 2 metrical quintals* are charged with fine metal previously heated till they are red hot, and in from one hour and three-quarters to two hours the bars are ready to be shingled. The waste of fine metal during this process is so trifling that it has been found on an average not to exceed from one to two per cent. The quality of the produce is excellent. One peculiar char-

* The quintal is about 221 lbs.—Com. Pub.

acteristic of puddling with gas is, that the formation and reduction of the scoriæ goes on at the same time.

The produce of the gas puddling furnace, amounts weekly to about 125 metrical quintals. The operation in the gas reverberatory furnace, presents also, as in the two preceding cases, very remarkable advantages; yet this operation has not been attended with such important results as those obtained in the refining-furnace and puddling stove, for the waste occasioned by the scoriæ in this case is very considerable, since it amounts to from twelve to thirteen per cent., and sometimes to more. The action of the stove is good, and the temperature sufficiently elevated, so that when no accident occurs, as many as 150 metrical quintals can be submitted to the action of the reverberatory furnace weekly.

After what has been observed, it will be seen that the result of the gas stoves and furnaces of Wasseralfingen, may be considered very satisfactory. According to the preceding data, bar-iron of excellent quality can be made with a waste which scarcely exceeds from twelve to fifteen per cent., and without any expense in the consumption of combustible; or, to speak more correctly, by making the application of a combustible which had hitherto remained useless. It is difficult at present to estimate the full extent of the important advantages which would result from using the gases which escape from blast-furnaces, according to the plan adopted by M. Faber; but it appears certain that this plan unexpectedly opens a vast field of improvement to the iron trade, and that it ought to occupy the serious attention of all who are engaged in this manufacture. Let us hope that, if any prejudices still exist, they will be removed by the great progress that has been made; the numerous and well-authenticated proofs of which do not admit of the least uncertainty with respect to an operation, the advantages of which may have hitherto appeared doubtful, because not sanctioned by experience. Mining Jour., September, 1841.

Method of Preventing Oxydation of Iron. By M. F. L. Allamand.

This composition, of a metallic nature, preserves iron and steel from oxydation, by entering into the pores without in any degree affecting their external appearance, or leaving the least blemish, so that steel instruments (including razors,) fire-arms, &c., retain their polish, and are in some degree better fit for use, after having been subjected to the metallic application. Articles either plain or chased appear superior to platina, and retain, after the application, all the hieroglyphic characters, figures, letters, and other engravings, or cuttings, which were there previously.

Composition of the Material.

Pure Malacca Tin, - - - - -	120
Silver filings, - - - - -	4
Yellow tincal, - - - - -	12
Purified Bismuth, - - - - -	12

Purified Zinc, - - - -	12
Regulus of Antimony, - - -	4
Nitre, - - - - - - -	11
Salt of Persicaria, - - - - -	1

Method of Purifying the Metals.—The tin ought to be melted separately eighteen times. Each melting should remain about twenty minutes exposed to the action of caloric, and the impurities which arise on the surface should be carefully removed; it is thrown afterwards into a ley formed of vine twigs and persicaria (herb) in equal proportions. The bismuth, the regulus of antimony, and the zinc are also melted separately, but they only require it twice, and they are carefully run into an ingot mould, so that all impurities may remain at the bottom of the crucible. The tincal does not require any purification.

Mixture of the different substances.—The tin is the first material that is melted; the silver is afterwards added to it in small quantities, and in a few minutes afterwards the tincal, then the bismuth and the zinc in succession. As soon as it is ascertained by the flame that the alloy is effected, the two kinds of salt are thrown in together, and are left to burn with vigour, and the alloy is stirred with an iron rod; after which it is carefully skimmed and poured into a vessel, to be made use of for the metallic application.

Method of applying the substance.—Before the piece of iron, or steel, is dipped in the recipient which contains the metallic mass already liquified, its surface must be rubbed well with a composition of sal-ammoniac and cream of tartar, in the proportion of five per cent. of tartar to the sal-ammoniac; the iron must then be dipped in the melted alloy, where it must remain only for a few seconds, and till it is perceived to be covered with a certain quantity of the metal. It is next placed in a wooden box of its own size, and in which there has been previously put a small quantity of sal-ammoniac and cream of tartar, in the proportions already indicated. It is again rubbed with a handful of tow, and a small quantity of the powder is put on the surface. In the course of this operation the steel loses it colour, and assumes that of silver. When this is done, it is again plunged into the metallic mass for a few seconds, and when it is taken out it is again lightly rubbed with the tow to remove any superfluous particles. The article being perfectly clean and shining, it is plunged into a basin of cold water, into which there has been poured a bottle of spirits of wine of forty degrees of strength, in the proportion of ½ per cent. After having withdrawn it from the water, the article is rubbed carefully with a linen, then it is rubbed as carefully with some fine sand, that has been moistened, to remove the spots of smoke: it is at last rubbed a second time with dry sand, then with a linen, and finally with a leather. After all these operations, which require great celerity in the execution, the iron will remain impervious to oxygen, and by care it will preserve all its whiteness.—*Inventor's Advocate.*

Civ. Eng. & Arch. Jour. for Oct., 1841.

On a Plan of Disengaging and Reconnecting the Paddle Wheels of Steam Engines. By J. Grantham.

There are four cases in which it may be desirable to disconnect the paddle wheels from the steam engine in steam vessels, viz., when the vessel is on a long voyage, and the fuel must be economized as much as possible by using the sails on every favourable opportunity; when the engines are damaged, and, the vessel being close to a lee shore, it is necessary to disengage the engines quickly, to allow the vessel to make sail; when some derangement has taken place, and the engines are allowed to continue to work imperfectly to the end of the voyage, rather than detain the vessel by causing the paddles to drag through the water while the engines are stopped; when, the vessel being at anchor, the action of the swell and tide on the paddle floats, while stationary, causes a great additional strain on the cables, which would be obviated could the wheels play freely. The Admiralty had called attention to the subject, by inviting plans for effecting it. Several had been proposed for disconnecting the paddles, but Mr. Grantham is not aware of any plan having been proposed by which the wheels could be readily reconnected in a heavy sea. The crank pins are usually fixed in the cranks of the intermediate shaft, a little play being allowed in the eye of the crank of the paddle shaft, to prevent the crank pins from breaking when the centres of the three shafts vary from a straight line by the yielding of the vessel. For the purpose of disengaging and reconnecting, a brass box of a rectangular form is inserted in the eye of the crank of the paddle shaft, which can be moved several inches by means of a screw at the back of the crank. The eye of the crank is so made that two of its sides may be cut away, and through these openings the crank pin can pass when the box is drawn back, or the disengaging effected. The brass box has one of its sides, which sustains the crank pin when in gear, cut away one or two inches to assist in reconnecting the engine, which is effected by screwing the box out one or two inches, or just so far that the crank pin can pass the side which has been cut away, and come in contact with the higher side. This is the correct position for reconnecting, which is accomplished by a single turn of the screw.

Ibid.

On the Propulsion of Vessels by the Trapezium Paddle Wheel and Screw.

Mr. G. Rennie gave an account of the various experiments to which he had been led, on the propulsion of vessels by various forms of paddle floats and by the screw. It was generally admitted that the paddle wheel was the best means of propulsion with which engineers were at present acquainted, and various attempts had been made for its improvement. There are several objections to the square or rectangular floats, particularly the shock on entering the water, and the drag against the motion of the wheel on the float quitting the water;

both of which give rise to considerable vibrations. He had been led, in considering the improvement of the paddle wheel, to have recourse to nature; and the form of the foot of the duck had particularly attracted his attention. The web of the duck's foot is shaped so that each part has a relation to the space through which it has to move, that is, to the distance from the centre of motion of the animal's leg. Hence he was led to cut off the angles of the rectangular floats, and he found that the resistance to the wheel through the water was not diminished. Pursuing these observations and experiments, he was led to adopt a float of a trapezium or diamond shape, with its most pointed end downwards. These floats enter the water with their points downwards, and quit it with their points upwards, and then arrive gradually at their full horizontal action, without shocks or vibrations; and after their full horizontal action, quit the water without lifting it, or producing any sensible commotion behind. After a great variety of experiments, he found that a paddle wheel of one half the width and weight, and with trapezium floats, was as effective in propelling a vessel as a wheel of double the width and weight with the ordinary rectangular floats. The Admiralty had permitted him to fit Her Majesty's steam ship *African* with these wheels, and he had perfect confidence in the success of the experiment. Another means of propulsion was the screw, which had been applied with success by Mr. Smith in the *Archimedes.* In examining the wings of birds and the tails of swift fish, he had been particularly struck with the adaptation of shape to the speed of the animals. The contrast between the shape of the tail of the codfish, a slow moving fish, and the tail of the mackarel, a rapid fish, was very remarkable,—the latter going off much more rapidly to a point than the former. From these observations he was led to try a screw with four wings, of a shape somewhat similar to these, but bent into a conical surface, the outline being a logarithmic spiral. He found also that certain portions of these might be cut off without diminishing the effect. With respect to ascertaining the friction of the screw on the water, great difficulty existed; but he would refer to his experiments, published some years ago in the Philosophical Transactions, in which he measured the friction of the water against a body revolving in it, by the time which a given weight took to descend; this body consisted of rings, and he found that the friction or resistance through the water did not increase in proportion to the number of rings. Ibid.

Supplementary Account of the Use of Auxiliary Steam Power, on board the "Earl of Hardwicke" and the "Vernon" Indiamen. By Samuel Seaward, M. Inst. C. E.

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper;* it was now further exemplified by the results of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

* See Journal Franklin Institute vol. ii, page 411—3rd series.

Earl of Hardwicke.—This vessel, of 1000 tons burthen, with one engine of thirty horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still with an advantage of twenty-nine days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived twenty-two days after her. During the voyage, the "Hardwicke" used her engines 364 hours, and was propelled by it 946 knots; an average of nearly three knots per hour: while in a calm, with the ship steady, she made five knots per hour. The total consumption of fuel was ninety tons.

The "Vernon," which sailed one month after the "Hardwicke," made her passage to Calcutta in ninety-seven days; passed the "Scotia," and arrived seven days before her, gaining forty-two days upon her during the voyage. The "Vernon's" consumption of fuel was also ninety tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "India" steam ship, of 800 tons burthen, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained twelve days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3,733 in favour of the "Vernon," on a single voyage, while she gained at least twelve days upon the "India," in point of time.

Ibid.

Some Inquiries into the Causes of increased Destructability of Modern Copper Sheathing. By Mr. Prideaux.

In May 1840, Mr. Prideaux was applied to by Mr. Owen, of Her Majesty's dock-yard, to analyze some sheet copper from the sheathing of the *Sanspareil*, which had been on thirty years, and was still in good condition. The sample gave about 0.25 per cent. of alloy, chiefly zinc and tin. This contrasted well with a sample rendered unserviceable in a very short time (in only one year,) and in which no quantity of alloy sufficient to weigh had been found; and the two agreed with two recorded analyses of Sir H. Davy and Mr. R. Phillips, the former having detected, in a very good sample of sheathing, about $\frac{1}{400}$ of tin; the latter having found the sheathing of the *Tartar* frigate (almost destroyed in four years, though never out of Sheerness harbour,) the purest copper he had ever analyzed; and further with the reputed inferiority of the recently prepared sheathing of the Royal Navy, which must have been much purified by the repeated fusions it has undergone. The inference adduced was, that the presence of tin and zinc was favourable to the durability of the copper. Mr. Prideaux, however, proceeded with the analyses in other cases. Four were selected, viz:

From the	Copper on	Annual loss.
Minden	17 years	0.45 per cent.
Plover	only 5	11

Linnet copper rapidly destroyed, could not be taken off sound enough to weigh a sheet.

New Sheathing prepared at Her Majesty's mills, Portsmouth.

There was no conformity between the results in these and the former experiments; they did not show any coincidence between the composition of the sheathing and its durability. The next step, therefore, was to examine how far it might be referred to any of the physical properties of the metal. To ascertain this, slips from each sample, all of equal surfaces (4 + 0.5 inch), were immersed each in a pint of sea water: The five vessels being placed side by side, so as to set them all in like conditions. Sea-water being electro-neutral, and acting *slowly* on copper, a little sal-ammoniac was added, to quicken the action without affecting the neutrality. The greatest waste was on the *Sanspareil* copper, which had worn the best of all; the least on that of the *Plover*, one of the worst. Thus, in the laboratory, under parallel circumstances, they do not observe the same order of durability and waste as they had done in use. The cause of comparative waste appears, therefore, to be in part at least, due to *external conditions*, and of these two classes may be noticed: one depending on the connexion with the ship, the other on the circumstances of her employment. Of the first class two suggested themselves—the position on the ship's side, and the nails by which the copper is fastened. The lower part of a ship's copper seems to suffer much less than the upper, so long as she continues in deep water; but when she grounds at low water, if on black mud, this part suffers most from the action of sulphuretted hydrogen, peeling off in blue flakes. The influence of the nails offers rather more chemical interest. They are never of pure copper, and being very numerous, all in contact with the copper sheets, whilst their heads present also a considerable metallic surface to the salt water, they may produce very decided effects, either preservative or destructive, by a slight electro-chemical difference. Mr. Prideaux therefore examined a vessel which they were just then stripping, her copper being worn out in four years. It was found that round some of the nails the copper was quite entire, for an inch or two, though worn ragged in other parts; whilst elsewhere, and sometimes on the same sheet, the copper round other nails was quite gone, though other fragments of the sheet remained. Here some of the nails appeared to have exerted a protective, others a destructive influence. To ascertain the effect of the nails, five slips of new copper from the same sheet, and of the same size, were suspended equidistant, and at the same depth, in a vessel of sea water from the West Indies. The result was, that all the nails, except one (which was from Her Majesty's dockyard,) appeared to act destructively. Here appears to be *one* instance of a protective nail, not enough so to prevent all waste of the copper, which experience has shown not to be desirable; but doubtless the preservative power may be increased to any requisite degree by attending to the composition of the alloy. The copper is alloyed

chiefly with tin; but if the nail is at once hard and flexible the manufacturer is satisfied without examining what other metals are present. If they were always made just so much electro-positive to the copper as to protect the sheathing, so far as compatible with their own durability, they would seem to offer the simplest, most perfect, and most convenient means of electro-chemical protection. The damage to which the copper is subjected is affected by the circumstances of the ship's employment. Sheathing suffers most where most subject to wash and air, for friction is an agent in the waste as well as oxidation. It is also well ascertained that the copper sheathing suffers most in hot climates, which might be expected upon a common chemical principle, that chemical action increases with the temperature; and it became a question whether this effect of heat, as well as its tendency to promote organic production and decomposition, might not form an important element in this destructive agency. Mr. Prideaux therefore obtained water from different parts of the Gulf Stream, with and without the weed, from the Caribbean Sea, and from Falmouth harbour, where the packets moored, the waters of which might possibly be affected by the mine drainings discharged into the river. Whilst these were being collected, Professor Daniell's announcement of large quantities of sulphuretted hydrogen in the waters of the Guinea coast came before the public. To try the action of these different waters five copper slips, of the same dimensions, cut from the same sheet, were suspended in a pint each of the following samples of water:

1. Heart of the Gulf Stream.
2. Do. with the weed.
3. Caribbean Sea.
4. Falmouth harbour.
5. Plymouth Harbour.

After thirteen days they were taken out and reweighed, having been put in all bright, but cleaned, on taking out, only with a brush in soft water, as in the other experiments:—

	1.	2.	3.	4.	5.
Put in 16th, ...	180.26	182.56	190	169.01	176.41
Out 29th, ...	178.45	182.3	189.6	168.55	176.1
Loss in 13 days,	1.81	0.26	0.4	0.46	0.31

No. 1, came out clean and bright, the others with tarnished surfaces, except No. 2, which was blotched and speckled. The Falmouth water presented no indications of being more corrosive than that of Plymouth, and Mr. Prideaux attributed the great difference of waste in these two cases to some unobserved difference of conditions in the experiment. But the excessive action of the Gulf Stream water, he considered too decided to be doubtful. Not only the quantity wasted, but the metallic clearness of the surface, showed a marked distinction. "But to whatever extent the recently increased waste of sheathing may fairly be charged upon the greater velocity, more constant employment, and greater consequent liabilities of weather and climate of our ships, particularly of the commercial classes, as well as

to difference in the nails, I am inclined," said Mr. Prideaux, "to fear the fault is still to be sought in the copper itself. I have it on the authority of Mr. Moore, that the *Quarantine* cutter, generally at anchor in our harbour, was coppered in October 1832, and her copper is now in a very good state. Her last sheathing held good 14 years. The Eddystone tender, which also moors in Catwater, was coppered in July, 1838, and it is now in much worse condition than the *Quarantine*, which has been on six years longer. That the waste on the Eddystone tender is not owing to her work, is evident, from the fact, that the upper part of her sheathing, which suffers the wash and friction, continues sound, whilst from beneath her floor the copper peels off in blue flakes. That this is attributable, in a great degree, to her occasionally grounding upon the black mud, which generates sulphuretted hydrogen and other corrosive matters, is very probable; the other never grounds, and does less work. Yet the difference is too great to be thus satisfactorily accounted for. The one is in good condition for nine years, the other comes to patch before the end of three: both lying the most of their time in the same harbour. On neither was there any distinct indication of protective or destructive influence in the nails." "Meanwhile, as nails must be used, and present a large metallic surface to the salt water, as well as numerous points of contact with the copper, calculated to give great effect to small electro-chemical differences, either in protection or destruction, it would seem that we ought to render them slightly electro-positive to rolled copper, by the addition of zinc, which would not injure their flexibility or enhance their cost. The test, by the galvanometer, would be easily applied (after a little practice) in making up the metal for casting them, if it is of importance to continue the present system of their manufacture."

There is another method of protection, which came out in the course of these investigations; and which is beginning to occupy public attention. It was before noticed, that the upper part of the copper on the Eddystone tender, which bears the wash and friction of the waves, continues sound; whilst the bottom is fast wearing out. This exception, or rather subversion of the usual conditions, is owing to a coat of fish oil, laid on when the copper was new, to keep it bright; and not extended over the parts out of sight. Such a permanent effect could never have been anticipated from an oil which is not drying, and strongly indicates the facility, as well as efficacy, of this mode of protection. A still more striking case presented itself in the vessel which supplied the observations on the apparent influence of the nails. During our examination, we observed the complete preservative effect of some coal tar, which had trickled down over the copper, from the wood-work above. This had crossed the sheets just where most subject to the wash and friction; and whilst the naked metal had been quite worn away, the coal-tarred streaks remained entire, the surface of the copper, on melting off the tar, being as perfect as when fresh from the roll. Hence coal tar seemed to be an efficient preservative; but then recurs the question—will it keep a clean surface, free from organic adhesions and earthy incrustations? To embrace the oppor-

tunity for experiments, the vessel was sheathed with copper on one side and yellow metal on the other; and her fore quarters to her mid-length varnished with coal tar, laid on hot, upon the metal also heated, by fires of chips round the sides. She has now been twelve months at sea; and, according to the last account, the varnished as well as the metallic surfaces, kept quite clean. Ibid.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Blast Furnaces for Iron Smelting. By S. W. Roberts, Civil Engineer. No. 2.

Esther Furnace; on Roaring Creek, in Cattawissa Township, Columbia County, Pennsylvania. Lloyd Thomas, manager and afterwards lessee. Observations first made Nov. 26th, 1839.

Fuel used *charcoal.* Blast heated in pipes at the tunnel head. Stack thirty feet high, lined with slate. Boshes eight feet, and tunnel head sixteen inches, in diameter.

Water in trunk two feet ten inches wide by twelve inches deep, and now flowing at the rate of 350 cubic feet of water per minute. Falls fourteen feet. Breast-wheel, twenty feet in diameter, with buckets three feet three inches long, makes nine revolutions per minute, which is at the rate of nearly nine and a half feet per second. Absolute power of the falling water, nine and a quarter horses, of Watt's steam standard. Probable power usually exerted by the wheel a fraction over five horses.

Two single-acting, wooden, blowing-tubs, each seven feet in diameter and eighteen inches stroke. The two tubs contain 115.45 cubic feet of air, and, making nine strokes per minute, they blow 1039 cubic feet of air per minute. The plan is that of Dotterer's patent blowing apparatus, having a third tub, between and over the others, to act as an air-vessel or regulator.

The blast is heated at the tunnel head, in fourteen cast-iron pipes, of three inches internal diameter, and six feet nine inches high. It is *sometimes* hot enough to melt lead.

Two tuyeres are used. The water-tuyeres are of wrought iron, and the nozzles are two and a half inches in diameter.

Went into blast April 25th, 1839, and up to November 24th had made 1115 tons 13 cwt. of pig-iron; or, on an average, thirty-seven tons per week for seven months. In some weeks forty tons were made. This furnace generally makes good foundry metal. The ore used is the rich, calcareous, ore from Montour's Ridge near Bloomsburg, which is used in a raw state, and yields from forty-five to fifty per cent. of iron.

Revisited the furnace May 19th, 1840, when it was again in blast, and making thirty-four tons of pigs per week. It then took twenty-eight half-charges in twenty-four hours, each half-charge consisting of twenty-four bushels of charcoal, seventy-five lbs. of broken limestone, and 800 pounds of raw ore. The materials consumed in making one

ton of pig-iron, were 138 bushels of charcoal, 432 lbs. of limestone, and two tons and 132 lbs. of ore.

Estimating twenty lbs. of carbon in a bushel of charcoal, and 1000 cubic feet of air blown per minute, will give 107 *cubic feet of air blown per lb. of carbon consumed.*

During the blast of 1840, which continued for ten months, 1300 tons of iron were made.

In 1841, low water and other circumstances caused a falling off, and the amount of iron made was about 900 tons in nine months. At a time when the water-wheel was making eight and a half revolutions per minute, the pressure of the air in the cold-air pipe was tested with a mercurial gauge, and it averaged seven-tenths of a pound per square inch.

Mr. Lloyd Thomas, the lessee and manager of this furnace, unites long experience in his business with practical common sense, and a desire to learn with a willingness to communicate what he knows.

New Photographic Discoveries. By M. Daguerre.

Translated for the Journal of the Franklin Institute, by Prof. Jno. F. Frazer.

The author, having isolated and then electrified the iodized plate of silver which he used in his former method, observed that he thus augmented prodigiously the sensibility of the coating which received the impression. It was then, in fact, sufficient in order to create the images, which the mercury afterwards rendered visible, to raise the screen and to let it fall again immediately.

In practice, this plan gave misty and streaked impressions, in consequence of the too great sensibility of the plate. Thus the bottom of the plate was longer exposed to the light than the upper part. And that this was the cause of the ill-success was proved by the fact that when the bottom of the screen was curved, the streaks upon the image were also curved.

The production of photographic images having thus failed, owing to the excess of sensibility of the electrified plate, M. Daguerre tried substances which were but slightly sensitive, no longer isolated the plate, and electrified it while in the focus of the camera but for a single instant, that is by a single spark. This experiment was successful. The material became extremely sensitive at the moment of the passing of the discharge, and the infinitely short duration of the phenomenon, did not prevent the formation of the image in the focus, or its fixture by the old method.

In this second mode of operating, the movements of the screen may be comparatively slow, without appreciable inconvenience.

Bulletin Soc. Indust., July, 1841.

On Explosions in Mines. By M. Graham.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

After such explosions the air is loaded with an enormous propor-

tion of carbonic acid which prevents prompt assistance to the workmen, while it is evident that the oxygen of the air is not, in a variety of cases, exhausted by the explosion. It is rendered irrespirable, however by five to ten per cent. of carbonic acid.

The best means of neutralizing that acid rapidly is to introduce a mixture, in equal parts, of slacked lime in dry powder, and glauber salts, which absorbs the acid with extreme avidity. A room containing air vitiated by any unwholesome gas whatever, may be entered without danger by causing the air to filter through a cushion an inch thick filled with this mixture placed carefully over the mouth.

Annal des Mines, 1840.

This, if the statement be worthy of reliance, would be an easy and excellent method of venturing safely and promptly to the relief of persons deprived of motion by descending incautiously into wells and vaults charged with foul air. TRANS.

Detection of Arsenic Acid. By M. ELSNER.

Translated for the Journal of the Franklin Institute, by Prof. JNO. GRISCOM.

It is well known that M. Runger discovers free sulphuric acid by covering a porcelain dish with a solution of one part of sugar and thirty parts of water, heating the dish by exposure to steam till it acquires the same heat, and then dropping on it the liquid supposed to contain the free sulphuric acid. A black colour indicates the presence of this acid, because the greater number of other free acids do not decompose the sugar in this manner.

I have found that arsenic acid acts in a peculiar manner, producing on the porcelain coated with sugar a beautiful scarlet red colour. The reaction is sensible with a liquid containing only $\frac{1}{1200}$ of arsenic acid. The action of the arsenic acid produces on the sugar ulmic acid, which brings the former acid to an inferior degree of oxydation.

Ibid.

Note on the Preparation of Sulphate of Iron. By F. BOUDET.

Translated for the Journal of the Franklin Institute, by Prof. JNO. GRISCOM.

Put into an earthen vessel 1000 parts of water, 330 parts of sulphuric acid at 66°, and add by piecemeal 200 parts of filings or turnings of iron; when the effervescence is over, pour the whole into an iron kettle and boil it rapidly until the liquid marks 35° on the pèse sel. Pour this liquid immediately on a filter impregnated with water acidulated with sulphuric acid, and place in an earthen vessel into which has been previously put 12 parts of sulphuric acid diluted with equal parts of water well mixed together. Stir the solution gently, so as to mix it with the acid and leave it to crystalize.

The crystals drained through funnels and dried rapidly, may be preserved a long time in dry, well closed vessels, without alteration; they are of so pale a white as to appear almost colourless when in small pieces.

Ibid.

On the Protection of Iron by Zinc. By M. Munkel.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

M. de Althaus, director of the salt works of Durrheim, has succeeded in protecting completely the evaporating pans of the works, thirty feet in length, by nailing to them on the outside, bands of zinc; and he observes that it is not necessary that the two metals be nicely polished at the points of contact. This fact, proved by a trial of more than ten years, lends support to the theory of contact. Ibid.

New Theory of the Galvanization of Metals. By N. Schonbein.

Translated for the Journal of the Franklin Institute, by Prof. Jno. Griscom.

Iron, zinc, and copper, become oxydized in the air, in water, and in saline solutions, as well when they are united by contact to other metals, or attached to the poles of a pile, or when they are isolated; but if a current can become established, how weak soever it may be, then one of the metals which serves as the negative pole, or, which is the same thing, which receives the hydrogen, is no longer oxydated as before. It follows from this that the protection of copper by iron is due to a chemical decomposition of the water in question, how feeble soever the junction. It results from my experiments:

1. That neither common nor voltaic electricity is capable of modifying the chemical properties of bodies, and that, consequently, the electro-chemical theories of Davy and Berzelius can not be admitted.

2. That the modifications which certain bodies undergo with respect to their chemical properties when subjected to contact, are due to the production of some substance and its deposition on these bodies by the action of the current.

3. That the most certain mode of protecting oxydizable metals against the action of free oxygen dissolved in water, is to place them in a voltaic circuit composed of the metal in question and a more oxydizable one, and the whole in an electrolytic fluid, like water, which contains hydrogen. Ibid.

Prevention of Explosion in Steam-Engine Boilers.

The Gold Isis Medal of the Society for the Encouragement of Arts, &c., was presented to Mr. Robert M'Ewen, Glasgow, for his Double Mercurial Safety-Valve for Steam-Engine Boilers.

There are two evils against which it is especially necessary to provide in the construction of an apparatus for preventing explosions in boilers, viz. the possibility of the steam passage being intentionally closed, for the purpose of obtaining extraordinary pressure; and the failure of the self-action of the apparatus through the accidental derangement of its parts.

Mr. M'Ewen's apparatus consists of a pair of open tubes, the ends of which are immersed in mercury contained in cups connected with the boiler by a pipe. At the junction of this pipe with its branches for the two cups, is a three-way cock, the ports of which are so pro-

portioned to the openings of the branch pipes, that the steam can neither be opened on, nor cut off from, both cups at the same time. The mercury tubes are proportioned in length to the greatest pressure which the boiler will bear with safety; the mercury will therefore be blown out of the acting tube into the dome at the top, whenever the pressure exceeds this limit, and will fall down through the other tube into the empty cup, while the steam blows out through a pipe at the top of the dome.* When the pressure is sufficiently reduced, the cock may be turned, and the cup which was last filled becomes the acting side of the apparatus.

On the 7th of April, a committee of the Society inspected the action of Mr. M'Ewen's mercurial valve, the apparatus having been attached to the boiler at the works of Messrs. Fairbairn and Murray of Mill Wall. The steam was opened on the mercury at a pressure of five pounds to the square inch, and as soon as it attained the pressure corresponding to the length of the tubes, viz. seven pounds, the mercury was blown, without any loss, into the dome and fell into the empty cup, while the steam blew out through the pipe at the top of the dome, and was condensed in a vessel placed to receive it for the purpose of experiment. On examination of the water in this vessel, not a particle of mercury was found in it. This result sufficiently proved the efficiency of the pipe, which is produced to some distance downwards within the dome, as represented in the section fig. 1, for the purpose of preventing the mercury from splashing out with the rush of steam.

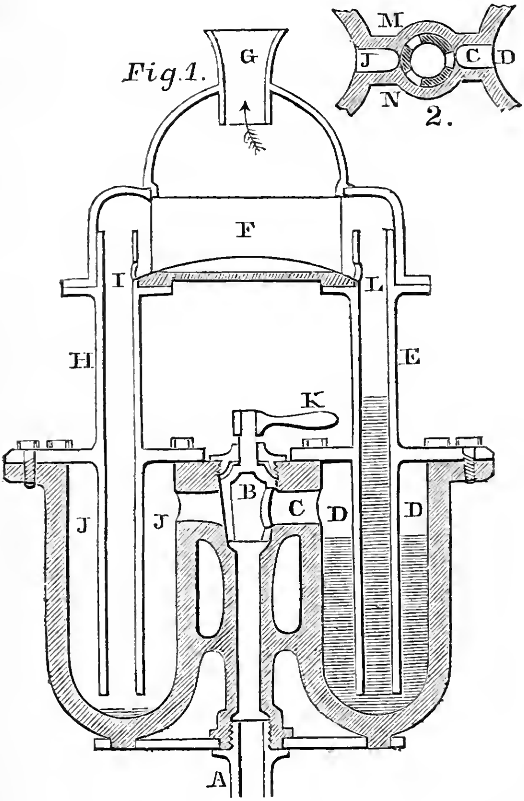
As the action of this apparatus depends simply on a *physical* principle, viz. the opposition of the elastic force of steam to the static pressure of mercury, without the intervention of a *mechanical* obstruction of any kind, it cannot fail of acting, so soon as the pressure of steam exceeds the limit corresponding to the length of the tubes. The novelty of the invention is in the employment of a mercurial tube as a safe vent for the steam, these tubes having hitherto been used only as indicators of steam pressure, being long enough to allow the steam to attain a dangerous pressure without relieving it or giving any other notice of the fact than what may be observed by the eye.

Figure 1 represents the whole apparatus in section. A, the pipe connected with the steam boiler; B, the hollow plug of a cock with a side opening at C, through which the steam passes into the area D, and pressing on the mercury causes it to rise in the tube E, till its weight counterbalances the force of the steam; the tube E opens into the chamber and dome F, to which there is free access for the atmosphere through the neck G; if, therefore, the steam should at any time exceed the due pressure which is limited by the length of the tube E, it will drive all the mercury before it up this tube into the chamber F, and will escape through the neck G; in the meantime the mercury will enter the opposite tube H through the small hole I, and flow down into the other vessel J, where it will be ready again to act as a safety-valve as soon as the attendant has turned round

* Mr. M'Ewen intends that an alarm-whistle be placed in this opening, and also that the apparatus serve as a gauge for indicating the variation of pressure, by means of graduated float-rods in the mercury tubes.

the plug B by its handle K, thus cutting off the communication of the steam with the vessel D, and opening it into the vessel J. The construction of both sides of the apparatus being exactly alike, the tube E having an aperture at L to receive the mercury from the chamber F, this operation may be repeated as often as the escape of the steam gives notice of its being necessary. The bottom of the chamber F, though straight from L to I, is curved like a trough in the cross diameter, as shewn by the curve under F, to conduct all the mercury through the hole I or L, whichever may be opposite the acting tube.

Fig.1.



2.

For the sake of perspicuity, only one side opening from the plug B has been adverted to. But the plug is always made with three openings, as shewn in fig. 2, at C, M, and N; by which it will be seen that it is impossible to shut more than one of the chambers, D or J, at the same time. The engineer, therefore, has not the power of completely shutting off the steam by means of the cock, nor could a successful attempt be made to effect this by plugging the pipe in the dome, the material of the latter not being of sufficient strength to bear as high a pressure as the boiler. Trans. of the Soc. of Arts, &c.

Progress of Civil Engineering.

Management and Direction of Railroads.

While every attention and care has been bestowed upon the construction and improvement of railroads and their machinery, but little has been done towards improving and perfecting the system of management of these works, after their completion. That this neglect is unwise in the extreme, is very evident, for the best constructed and most substantial work can be so managed as to become, in a few years, a mere ruin, and as unprofitable to its owners, as if it had never possessed any advantages. That this error has been in a great degree a cause of the unsuccessful operation of many works for which a far different fate had been reasonably anticipated, cannot be denied.

The management of a completed work resolves itself into two departments,—the engineering and the financial. The former of these is the most important, as upon it alone will depend the prosperous condition of the work;—the latter should be managed simply with a view to the proper collection and disbursement of the monies received.

Our object at present is to make a few remarks upon that portion of the management of public works which belongs more properly to the engineering department, and we are the more anxious to do so, as this is a point which, in our opinion, has been sadly overlooked by the direction of railroad companies. No one would think of committing the equipment and sailing of a ship to the supercargo, although the captain is frequently entrusted with the sale and purchase of cargoes, and the reason of this is obvious, for while the science of navigation requires the experience of years, the mercantile knowledge necessary in the purchase and sale of goods, under general directions from owners, is very simple and easily acquired. But in the management of railroads, a very different system prevails,—the supercargo sails the ship, attends to the repairs, and has unlimited control over things of which he has no knowledge, and is not likely to acquire any, unless at the expense of the owners,—or in other words, the management and repair of the road and machinery, are too often placed in the hands of those as ignorant of engineering as a supercargo is of seamanship. It cannot be expected that when a rather complicated system of machinery has been put in operation at great cost, not only of money but of the labor of professional men, that the whole can at once be handed over to persons of entirely different habits and attainments, for their exclusive control, unless at great hazard.

Although many companies have undoubtedly been so fortunate as to secure the services of non-professional persons, highly capable of carrying on the mechanical department, it is yet to be considered whether the influence of a respectable engineer is not calculated to operate to better advantage for the interest of the company, than the mere opinion of an individual generally under the control of one or

two directors. We need no better evidence upon this head than the comparative success of those roads which are under the superintendence of engineers, and those upon which no such arrangement prevails.

The great objection to the employment of resident engineers as general superintendents of railroads, is the expense. Retrenchment and reform are the great words of the day; but that they always mean what they profess to mean, we are by no means willing to admit. It is considered a great master stroke in financiering, particularly on the coming in of a new board, to show how much of the current expense of the road has been, or rather is intended to be, cut off. Great eclat attends this curtailment, while but few think of looking into the accounts to see whether what has so suddenly been taken off at one end, has not been as suddenly put on at the other. There are few items of expense more insidious than wear and tear of machinery, and it is quite possible that with the same amount of receipts, a reasonable profit may remain in one case, or be eaten up in another. Moreover, the condition of a railroad track has an important influence upon the machinery, and a false economy upon the one, may be imperceptibly bringing ruin upon the other—the yearly expenses are shown to be small, and stockholders are annually gratified by a fair detail of monies saved, and by good dividends—but in a short time the whole road and every thing belonging to it are racked to pieces.

Proprietors should recollect that it is the interest of those in power to retain their influence, and they themselves are too apt to look at the present value of the stock—but while this is well enough for dealers in stocks, it is proper that those who look for permanent investments should keep an eye to the preservation of suitable checks upon a speculative spirit. The tendency of the times is so much towards the abuse of power in the hands of corporations or rather of a few individuals in these bodies, that great care should be taken to avoid even the appearance of evil, and no better means can be taken to advance the character of railroads as an investment, (and good roads are already favorites,) than by establishing a check upon the financial direction, which may prove to stockholders that all is fair and above board, and that the condition of their property is not yearly depreciated to swell the amount of their *apparent* profits. To prevent this, proprietors of railway stock in particular, should not be so derelict of their true interests, as not to follow the example of England, in having annual *competent* investigations into their condition and management.

But it is by no means necessary, that the intention to deceive should exist, to produce the same results. Self-deception may prove as fatal as downright fraud; why then trust to those who are most likely to be misled because they are not even supposed to possess the proper information? It is but a poor comfort when money has been lost, to say, that it has happened rather from the ignorance than the dishonesty of those to whom it has been entrusted.

But the expense of employing engineers in such situations has been greatly overrated. When railroads were first introduced, the demand for civil engineers was far greater than the supply, but at present, very many competent and experienced men can be found who would be the means of saving more than the most liberal salary would cost. Moreover, the expense of superintendence alone would hardly be increased by such an arrangement, for the substitution of one responsible and intelligent head for several offices, would in itself, in some cases, at least be the means of saving expense.

This subject is one upon which much more might be said, and to which we hope again to return. The character which the profession will attain when properly united and organized, will have great influence upon the whole railroad system, and to such an organization do we look with the earnest hope that among many other important topics, the present will receive their attention, and much assistance to the cause be derived from the information thus accumulated.

American R. R. Jour. Nov., 1841.

Memoir of the Montrose Suspension Bridge. By J. M. Rendel, M. Inst., C. E.

Previous to the year 1792, the passage of the River Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progress of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R. N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were—

	Feet.
Distance from centre to centre of the towers,	432
Deflection of the chain or versed sine of the catenary,	42
Length of the suspended roadway,	412
Width of do do	26
Height of do do above low water,	21
Do of the towers do do	68
Base of the towers at the level of the roadway,	40 by 20
Archways through the towers,	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base on the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, twelve inches apart. Each chain was composed of four bars of iron, five inches wide by one inch thick, and ten feet long, united by short plates, and strong wrought iron pins. The roadway was suspended to these chains

by perpendicular rods, one and a quarter inch in diameter, attached at intervals of five feet, alternately to the upper and lower lines of main chains, at the joints, which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast-iron bearers for supporting the roadway.

Upon these bearers was laid and riveted, longitudinally, a flooring of fir planks, three inches thick, and well caulked; upon this a sheathing of fir, one and a quarter inch thick, was placed transversely, and spiked to the lower planks; over all was spread a coating of about one inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, ten feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area forty inches—thus giving six chains of twenty inches area each, instead of four chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appears that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart many of the traversing pins were found to be bent, and some of them were cut into, evidently by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended; also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what

he deemed defects in the construction of the roadway, but as there was no positive symptoms of failure, it was allowed to remain. He conceived that in the anxiety to obtain a light roadway, mathematicians, and even practical engineers, had overlooked the fact that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, vol. 3, of the Transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings, or moorings, quite sound; the principal portion of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attributes to the failure of the suspension rods, which, having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menai Bridge* induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose Bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to distribute the load, or the effect of any violent action, over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays, or braces, to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed, should distribute its weight uniformly over the chains, not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were one and five-eighths of an inch in diameter down to the flexible joint at the level of the platform; below that joint the diameter was increased to one and three-fourths of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers, cross beams were substituted, composed of two Memel planks, thirteen inches deep, three and a half

* Minutes of proceedings, pages 167 and 204.

inches thick, bolted together, and trussed with a round bar one and one eighth inch diameter; every sixth beam had a deep trussed frame on the under side, so as to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of ten feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, eleven inches by six inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, two inches thick, laid transversely from the inner longitudinal beam to the outer curb piece with an inclination, or drip, of one and a half inch in five feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each two inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, two inches thick. Over the whole was fixed, transversely, a layer of slit battens, one and a quarter inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of one inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, six inches square, with their ends stepped into the cast iron boxes, which, at every ten feet, grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed three feet six inches above, and the same depth below the roadway; an iron screw bolt, one and a quarter inch diameter, at every ten feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal planking giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was—	Tons.	Cwt.
Wood work, - - - -	130	19
Cast and wrought iron about ditto, -	36	6
Wrought iron in the suspending rods, -	20	14
Do. do. fencing, - -	8	18
Gravel concrete, - - -	30	0
Total, - - - -	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

The weight of the original roadway was—	Tons.	Cwt.
Wood work, - - - - -	69	0
Cast iron about ditto, - - - - -	92	0
Wrought iron in the suspending rod, -	12	9
Gravel concrete, - - - - -	30	0
Total, - - - - -	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4026 or about 7s. 3d. per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platform has given confidence in its strength to all who have examined it. Civ. Eng. & Arch. Jour., Oct., 1841.

Experiments for determining the position of the Neutral Axis of rectangular Beams of Cast and Wrought Iron and Wood, and also for ascertaining the relative amount of compression and extension at their upper and under surfaces, when subjected to transverse strain. By JOSEPH COLTHIRST.

These experiments were undertaken in consequence of the difference of opinion which has long existed respecting the position of the neutral axis of extension and compression of iron and wood.

First experiment.—Two series of experiments were made to determine this point by cutting through the centre of each of a set of eight girders, each six feet six inches long, five inches deep, and half an inch thick, the first to the depth of half an inch, the second to the depth of one inch, and so on, to the eighth girder, in which only one inch of metal remained unsevered. The spaces cut out were then filled with carefully fitted wrought iron keys, and the girders were broken by the application of weights, in the expectation that these weights would be some indication of the neutral point of each girder. The results were, however, so irregular, that no satisfactory deductions could be drawn from them.

Second experiment.—The next attempt was made in the manner suggested by the late Mr. Tredgold, by drawing two fine lines, two and three-fourths inches apart, on a polished surface, at right angles to a girder, in the middle of its length; it was then subjected to strain, and dimensions were sought to be taken to determine where their divergence and convergence commenced, but the differences were too small to be susceptible of accurate determination, otherwise than by a fine micrometical operation, which at the time the author had not an opportunity of applying. The following plan was therefore adopted:

Third experiment.—In the side of a cast iron girder, six feet six inches long, seven inches deep, and one inch thick, a recess was planed at the centre, three inches wide by a quarter of an inch deep. This was filed up very true, and 14 small bars of wrought iron, with coni-

cal ends, were placed in it at regular distances of half an inch apart. These bars were of such lengths as to hold sufficiently tight to carry their own weight, and yet that the slightest touch should detach them. The girder was then subjected to strain. The supports were six feet apart; with a strain equal to 100 pounds, the lower bar fell out; as it was increased, they continued to drop, and with 1500 pounds, all those below the centre had fallen. The strain was then increased to 7000 pounds, but no more bars fell. The centre bar remained exactly as when put in; all those above the centre became firmly fixed, and were evidently under considerable compressive force. The strain was then gradually taken off, and all the bars above the centre fell out, their ends having become compressed by the sides of the recess pressing on them; they were, of course, too short when the girder resumed its former condition, and the recess its previous width. These experiments were repeated several times, with pieces of fine wire and dry lance-wood charred at the ends.

The result in every case showed that the *neutral axis* of extension and compression was certainly situated within $\frac{2}{10}$ of an inch of the centre.

Another experiment was still more decisive. A girder nine feet six inches long, eight inches deep, one inch thick, was cast with two brackets or projections on the side, each nine inches on either side of the centre. A brass tube bar, with circular ends and a sliding adjustment, was fixed between the brackets, which had been filed true. The clear bearing was seven feet six inches; a strain of fifty pounds was sufficient to cause this bar to drop out; and with 250 pounds the whole effect of the previous experiment was produced. The tube, when placed loosely, one inch above the centre, was held fast by a strain of 1000 pounds.

Wrought Iron.—Similar experiments were then made on wrought iron, with precisely the same results, showing that the neutral axis, if not actually situated at the centre, was nearly identical with it.

Wood.—A similar series of experiments, made upon wood beams, gave exactly the same results as regarded the position of the neutral axis.

From all the foregoing experiments, the author concludes that the neutral axis of extension and compression in rectangular beams of cast and wrought iron and wood, is situated at the centre of their depth, when those beams are subjected to transverse strains.

Extension and compression. Cast Iron.—Experiments were also instituted to ascertain the amount of extension and compression of cast and wrought iron and wood.

Upon a bar of cast iron, three inches square, and nine feet long, two strips of thin hoop iron were attached, the one on the upper, and the other on the lower side, each strip being fastened to the bar at one end only, while the other end was left free; any change which occurred in the length of the surface to which it was applied was clearly indicated. The differences were recorded by very fine lines on a polished surface. The strips were seven feet six inches long, and were bound to the whole length of the beam by bands of fine wire,

wound round and enclosing them at every nine inches; the beam was then subjected to strain, and the following results were obtained:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
1000	0.22	. . .	. . .
2000	0.45	0.04½	.04½
3000	0.65	0.06	0.06
4000	0.87	0.08	0.08
5000	1.20	0.11	0.12
6000	1.50	0.13	0.14

6240 the beam broke; good iron, showing a good clear fracture.

It will be perceived, that until rather more than two-thirds of the breaking weight was put on, the amounts of extension and compression did not sensibly differ, but between that point and the breaking weight, extension yielded in a higher ratio than compression.

Wrought Iron.—Similar experiments were next made on bars of wrought iron, two and a half inches square; the supports were thirteen feet six inches apart, and the strips of hoop iron were twelve feet long.

Weight. lbs.	Deflection. inches.	Compression. inches.	Extension. inches.	Elasticity. impaired.
500	0.55	0.03	0.03	. . .
1000	1.55	0.06	0.06	. . .
1280	1.45	0.07	0.07	0.15
1560	1.85	0.08	0.08	. . .
1800	2.20	0.09	0.09	. . .
2000	2.70	0.11	0.11	0.65
2280	4.15	0.18	0.19	2.05

With this weight the beam was permanently bent, and its elasticity nearly destroyed.

These experiments showed that, differing from cast iron, the amounts of extension and compression in wrought iron continue to be equal up to the complete destruction of the elasticity of the beam.

Fir battens.—The amounts of extension and compression in rectangular beams of fir timber, when subjected to transverse strain, were next determined; the manner of proceeding was precisely the same as in the preceding experiments.

A batten, four inches by three inches, with the supports eight feet two inches apart, and with strips seven feet six inches long, when subjected to transverse strain, gave these results:—

Weight. lb.	Deflection. inches.	Compression. inches.	Extension. inches.
500	1.10	0.12	0.12
1000	2.30	0.24	0.24

Results.—From these experiments on the amount of extension and compression of cast iron, measured at the upper and under surfaces of rectangular beams, subjected to transverse strain, the author assumes, that within limits which considerably exceed those of elasticity, and equal to at least two-thirds of the breaking weight, there is no sensible difference between the amounts of compression and extension, and that

as the breaking point is approached, extension yields in a higher ratio than compression, and gives way first.

It would appear certain that up to the point when the elasticity of wrought iron is completely destroyed, and the beam is bent, the amounts of compression and extension continue exactly equal, and it is therefore probable that this equality would continue to the last.

It is clear that the amounts of extension and compression up to three-fourths of the breaking weight do not sensibly differ in fir battens, but that as the ultimate strength of the beam is approached, compression yields in a much higher ratio than extension and may be actually seen to give way first.

He states also, that the amounts of extension and compression are in direct proportion to the strain, within the limits of elasticity and that even after those limits are greatly exceeded, and up to three-fourths of the strength of a beam, they do not sensibly differ.

Ibid

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1841.

With Remarks and Exemplifications by the Editor.

1. For *Forming Dovetailed, or Oblique, Catches, or projections, on plates cast from iron* or other metal; Jordan L. Mott, City of New York, December 1.

The patentee says—"These catches or projections are such as are required and used for holding latches, the retaining of stove feet, dovetailed wedges on railroad chairs, and for a variety of purposes similar in character, and well known to founders. The ordinary mode of forming projections for the catches to latch, or retain in place, the doors, or other parts of stoves, and of forming the dovetailed grooves for receiving and retaining the legs of stoves, and of producing projections on cast articles for numerous other purposes, has been by the use of sand cores, or of movable pieces on the pattern, which pieces are taken from the mould after the removal of the main plate, or piece of casting. Instead of employing these, or similar devices, I make holes through the pattern in the part where such projections are to be formed, or through a plate, or piece of metal, or of wood, which may be laid upon the proper part of the mould after the main pattern has been removed, and through these holes I force a punch, or piece, adapted thereto, which is to be so formed as to make an impression in the sand of the exact form required, by which means said impression will be produced with much greater facility and truth than by any of the methods heretofore used or known."

"I am aware that it is a common practice among founders to form depressions in the sand by pricking through holes made in the patterns for that purpose, so as to produce pins, or shanks, on the casting to be obtained, and I do not therefore claim the so doing as of my in-

vention; but it has never been attempted, as I verily believe, to form catches, dovetailed openings, and other devices of a like character, by means of an apparatus such as I have described. What I claim, therefore, as constituting my invention, and desire to secure by letters patent, is the manner herein described of forming such catches and projections by means of a punch, or piece, properly formed for that purpose, there being corresponding openings through the pattern, or through a plate adapted thereto, as set forth."

2. For a mode of constructing a *Portable Combined Caldron and Furnace,* adapted to the use of Agriculturists and others concerned in the breeding of stock; Jordan L. Mott, City of New York, December 1.

The patentee says—"The furnace which I use is similar in its general construction to that for which I obtained letters patent dated the 19th day of October, 1838," (a notice of this will be found in vol. xxiv. of this Journal, page 287,) "upon this are elevated side pieces of cast iron which surround the caldron or boiler to be used, these side pieces occupy the place, and perform the office, of the brick work ordinarily used in the setting of caldrons, coppers and boilers, said case standing at such distance from the caldron as to constitute a flue space, through which the heated air from the fire shall pass in its way to the exit pipe." The side pieces which form the case are cast in sections, each occupying one-fourth of the circumference of the caldron; the sections being united by catches on the edges of each. The caldron is cast with a rim which rests on the upper edges of the segments and covers the flue space.

Claim—"What I claim in the above described apparatus as of my invention, and which I desire to secure by letters patent, is the combining of the portable furnace and caldron, or boiler, by elevating the sides of said furnace, and connecting therewith the sectional side pieces which constitute the flue surrounding the caldron, or boiler, the whole being constructed, combined, and operating substantially as described."

3. For improvements in *Locks and Keys;* William Morrett Williams, Middlesex county, England, December 1.

This is a modification of the well known combination lock. The lower edge of the bolt, which is cut into square notches like a rack, slides in what is called a rack box, through which any given number of notched plates slide at right angles to the bolt, and when the notches in all the plates coincide, the teeth of the rack, on the bolt, pass freely through them; but when any one of the plates is pushed in too far, or not far enough, then the bolt cannot slide. Each plate is acted upon by a separate spring. The key consists of a plate with as many pins projecting out from it as there are sliding plates in the lock, and the length of these pins is so adjusted with reference to the notches in the plates that, when pressed upon the sliding plates, the notches in all of them are made to coincide, and permit the bolt to

slide. This arrangement is described as applied to door looks, to padlocks, and to liquor locks.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the manner in which I have combined the rack on the bolt, the rack box, the sliding pieces, and the respective springs, lever and other parts, so as to be acted upon by means of the key or other instrument for opening and closing the same, the whole being constructed and operating substantially as herein set forth in the application to a padlock. I also claim the application of the same principle or general manner of construction, as herein exemplified, in its application to door locks, and to the securing of cocks or taps for the drawing of liquids, and also to all other objects and purposes to which it can be applied, whilst the principle of construction, and manner of operation, remain substantially the same."

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4. For an apparatus for *Heating Buildings by the circulation of hot water through tubes;* Geo. M. Dexter, Boston, Massachusetts, December 1.

The furnace and the tubes through which the heated water circulates, are arranged in an air chamber, the air within which, when heated, is to be carried off to other apartments, or otherwise employed, as may be desired. The furnace is vertical and surrounded with water except at the door for the supply of fuel. A system of vertical and horizontal tubes communicate with the water chamber of the furnace at top and bottom, by means of which connexion the water is kept in constant circulation.

Claim.—"What I claim as constituting my invention and improvement, is the heating of air in a chamber constructed for that purpose, within which chamber there is a system of tubes, which tubes are heated by causing water to circulate through them in the manner set forth, said water being at a temperature below that of boiling, and being supplied by a heated vessel arranged and operating substantially in the manner described, and the air so heated being conveyed from the said chamber through large trunks, or other openings, into the apartments to be warmed, as made known."

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5. For a *Sled for transporting Blocks of Ice* on rivers and lakes; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This sled is provided with runners on the top, the surfaces of which are bevelled inwards, thus forming a sharp edge on which the blocks of ice will slide easily, and by which they will be prevented from passing off side ways. The claim is confined to the device of beveling the slides inwards.

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6. For improvements in *Cutters for Cutting Ice* of any thickness, or to any required depth; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

Any desired number of cutters are attached to a beam which is

provided with handles, and to which a horse or horses are attached. These cutters are curved, and their forward edges are grooved; they are made wider on the front than on the back, the front being spread out so as to form cutting edges, by which construction the chips that are cut run up on the front edge of the cutters and are discharged at top through an enlargement made for that purpose.

Claim.—"Having thus described my improvements, I claim as my invention the forming of the chisels of ice cutters, of the curved shape in front and rear, as hereinbefore specified, and likewise grooving the front or curved cutting faces of the chisels, and constructing the same wider than the rear, or with lateral cutting edges, for the purpose of effectually removing chips of ice or other extraneous matters, from the sides of the grooves."

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7. For machinery for *Raising Blocks of Ice from the water* of a pond, lake, or other frozen surface of water, and depositing the same on a sled on which they are removed to the storing houses, &c.; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This machine consists of an inclined rail way and a gig. The gig is sunk in the water, and on being raised brings up a block of ice which is deposited on the rails, down which it slides to a sled properly situated to receive it.

The claim is to the "raising of blocks of ice from the water and depositing the same on a sled by means of the apparatus denominated the gig, in combination with a rail way, &c."

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8. For improvements in machinery for *Reducing Blocks of Ice to a uniform thickness,* and cutting parallel ridges on the upper surface of the same; Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

The patentee says—"The first object of my invention is to reduce the blocks of ice to a uniform thickness, so that they may be easily and completely stowed either in the houses or depots, when first collected in the wagons on which it is transported to the vessels for shipment, or in ice houses abroad for ultimate sale, and in general to facilitate every stowage and removal required in the ice business. The next purpose intended to be effected, is the raising of parallel ridges on the upper surface of the blocks, on which the succeeding layers, when packed in the ice house where first collected may rest, thus keeping the residue of their surface apart and preventing the same from freezing together, which generally takes place owing to the melting of the upper layers of ice, and percolation of the water downwards between the blocks, where it freezes and cements the whole into a mass, thus often rendering it difficult and expensive to remove the blocks in good and fair shapes for such purposes as may be required. Lastly the snow ice which often accumulates on the upper surface of the blocks can be easily removed when the ridges are formed."

The blocks of ice slide on a railway, and each block is taken in

succession by the catches on a forcing reciprocating carriage, and forced against a set of knives which reduce it to the required thickness, and leave the ridges on the surface.

The claim is to the "forming of ridges on the surface of blocks of ice, and reducing the remainder of the blocks to a uniform thickness by means of the shaves and chisels, and a forcing carriage in combination with a railway under the same, the whole being arranged and operating together substantially in the manner and for the purpose specified."

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9. For an improvement in the manner of *Taking Measure of the Human Body for the purpose of Drafting and Cutting Coats;* Thomas E. Tilden, Baltimore, Maryland, December 5.

The patentee says—"My first improvement consists of a simple instrument which I denominate Tilden's Daguerreotype, or transfer ruler; and my second improvement consists in the manner of applying the common tape measure, divided into inches and parts of inches, so as to draft and cut from a point, or points, ascertained by the transfer ruler, which system of measuring I denominate Tilden's Balancing system."

The transfer ruler is simply a straight strip of wood, having a spirit level fixed on the middle, or on any other convenient part, of one of its flat sides, and two sliding arms which project out from said ruler at right angles to its length, and by the use of this, and the ordinary measuring tape, all the required measures are obtained. We are under the necessity of omitting a statement of the manner of using the instrument and the tape, as also the mode of laying out the coat, as it would carry us beyond the limits allotted to us.

Claim.—"What I claim as new and desire to obtain by letters patent, is first, the manner of constructing and using the instrument which I have called the transfer ruler, for obtaining a point on the back of the person to be fitted, which shall be in the same horizontal line with the under part of the arms, and for obtaining two such points where the arms, or shoulders, are of unequal height, from which point, or points, the principal measures, constituting my balancing system, are to be taken. Secondly, the manner of taking what I have called my second shoulder measure by the aid of said point or points; also the manner of taking my third shoulder measure as related to and employing the said point or points; and lastly, I claim the manner in which I take what I have herein called my balance measure, and of using the same in drafting for the purpose of cutting, so as to test and balance the respective measures obtained by the mark, or marks, on the middle of the back."

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10. For *Manufacturing Fair Leather;* James C. Booth, Philadelphia, Pennsylvania, December 5. (See Specification.)

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11. For an improved *Padlock;* Soloman Andrews, Perth Amboy, New Jersey, December 5. (See Specification.)

12. For an improvement in the *Axles and Boxes of Carriage Wheels;* Asa R. Reynolds, Skeneateles, New York, December 5.

The patentee says—"The object of my improvement is to obviate the injury resulting to the shoulders, or end bearings, of the axles and boxes of carriages from the continued jolts or blows, of said end bearings against each other when a carriage is running; and also to provide for the easy repairing of such axles and boxes, when the shoulders are worn, and too great a degree of end play is thereby produced. The first of these difficulties I obviate by the insertion of aspiral, or other spring, within suitable recesses formed in the axle and box, in such a manner as to cause such spring or springs to take off the force of the blow from the end bearings, or shoulders. The second I remedy by the insertion of a steel ring, or ferule, which shall form a shoulder, or bearing, and by the renewal of which, at any time when necessary, the axle and box are rendered as perfect in their end bearings as at first."

"I do hereby declare that I do not claim to have made any improvement in the manner of attaching such axles and boxes to each other, but intend to apply my improvement to them under all their various modifications. I confine and limit my claim, therefore, to the insertion of springs, preferring those of the spiral kind, in such manner as that said springs shall act upon the shoulders or end bearings, of such boxes and axles, and relieve them from the immediate and injurious effect of the blows and jolts to which they are subjected when in use. And in combination with such springs, so applied, I claim the application and use of hardened steel ferules, or rings, to constitute the rubbing parts of the end bearings, as set forth."

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13. For an improvement in *Artificial Teeth;* Daniel Harrington, Philadelphia, Pennsylvania, December 10. To run fourteen years from June 18, 1840.

The improvement claimed under this patent is in the making of the ends of the platina wires, which are imbedded in porcelain or mineral teeth before burning, either in the form of screw or pin heads, or in the form of a staple, instead of in the square or chisel form heretofore practised.

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14. For a mode of *Connecting and Disconnecting Railroad Cars;* James Stimpson, Baltimore, Maryland, December 10.

The object of this improvement is to make the tie which connects the locomotive with the train of cars, and the cars with each other, in such manner that when one of the cars runs off the track it shall be disconnected from the others. The connecting apparatus consists of two springs united at one end by a loop which fits on a pin attached to the truck of one of the cars, the other ends being connected by a "forelock." This forelock is jointed to one of the springs, and catches in a mortise cut in the other. Within a proper distance of this

end of the springs there is a stud attached to each, so that the two overlap each other, and the two pins on the truck of the car with which this end of the tie is to be connected, are embraced between the forelock and the two studs. From the foregoing it will be evident that when the locomotive, or one of the cars, runs off the track, the springs will be spread apart by the two pins, which relieves the fore lock and liberates the tie.

The claim is confined to the combination of the spring jaws, forelock, studs, and the two pins on the car.

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15. For a machine for *Raising Blocks of Ice into Storehouses;* Nathaniel J. Wyeth, Cambridge, Massachusetts, December 10.

The machine described is to be erected over a railway, on which the blocks of ice are deposited from sleds. The blocks of ice are slid on to two rails attached to a frame called a "gig" which works up and down in slides; and where the blocks are to be discharged and to run into the storehouse, there are two receiving bars hung by hinges and sustained by chains, so that when the gig is drawn up, the edges of the blocks of ice lift the receiving bars, to permit said blocks to pass up, the bars then fall back, and catch the block, which slides into the storehouse, the receiving bars being inclined, and connected with four inclined rails, called side and centre pieces.

Claim.—"I claim raising blocks of ice to any required height and depositing the same in a structure by means of a hoisting gig in combination with the receiving bars, and side and centre pieces or rails; and I also claim the combination of the above with the railway which receives the blocks of ice from the sled, the whole being arranged and operating together substantially in the manner described."

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16. For an improvement in *Roofing Houses with Slate, Tile, or Metal;* William Docker, New Orleans, Louisiana, December 10.

This invention is for the purpose of dispensing with double courses of slate, tile, &c., by employing plates of sheet iron, tin, or zinc, japanned or lacquered, and placed under the joints of the slates, tiles, &c., which are laid in hydraulic cement or other water-proof composition. The upper end of the plates of metal are to lap over the lower edge of the preceding course of slates, &c., and the lower ends are nailed to the roof, the cement is laid on, and then the next course of slates, tiles, &c. affixed in place.

Claim.—"What I claim as my invention and desire to secure by letters patent is laying the slates, tile, sheets of metals, &c., constituting the roofing, in hydraulic cement, or other water proof composition, in combination with the intermediate plates, which plates should be covered with paint, varnish, lacquer, &c., in the manner and for the purpose described."

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17. For an improvement in the *Door Latch;* Oliver Ludd, Cherry Valley, Oswego county, New York, December 10.

This patent is obtained for an improvement in the mortise latch.

The latch is jointed to a plug of wood which is let into a hole bored in the edge of the door. The handle, or trigger, instead of having a joint pin is to lift up. It passes through the door and has a handle on each side.

The claim is to the method of fastening the latch; and the method of keeping the handle in place. The latter improvement could not be clearly understood without drawings.

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18. For an improvement in the method of *Fastening Buttons on Clothes;* Stephen Clapp, assignee of H. W. Hewet, New York city, December 10.

The claim will give a sufficiently clear idea of this invention, and therefore we will omit any explanation, viz:

"I do not claim to be the inventor of attaching buttons to clothes, &c. by means of a metal flanch having a stem passing through the button, as this has been patented, but what I do claim as my invention and desire to secure by letters patent is the method of uniting the button and flanch by means of a male and female screw, which are prevented from unscrewing by having a thread or pin of wood passed through them as described."

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19. For a machine for *Rolling Puddle Balls,* in the manufacture of iron; Henry Burden, city of Troy, New York, December 10.

The following claim will afford a general view of the nature of this invention, viz:

"What I claim as constituting my invention and desire to secure by letters patent, is the preparing of puddle balls, as they are delivered from the puddling furnace, or of other similar masses of iron, by causing them to pass between a revolving cylinder and a curved segmental trough adapted thereto, constructed and operating substantially in the manner of that herein described, or by causing the said balls to pass between vibrating or reciprocating tables, surfaces, or plates of iron in the manner described, or between vibrating or reciprocating curved surfaces, operating upon the same principle and producing a like result by analogous means."

A patent for this invention was obtained in England, in the name of Gerard Ralston, and an abstract of the specification is given at p. 31, vol. 1, of the present series.

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20. For a method of *Removing Straw from Thrashing Machines;* James Cummings, Cecil, Pennsylvania, December 10.

The straw is discharged from the thrasher on to a concave of slats, over which a wheel of rakes revolves; the teeth catch the straw, and throw it on to an endless belt of slats, and, as the straw is raked off, the grain falls through between the slats.

The claim is to the "mode of conveying the straw from the thrasher by means of a wheel of rakes placed over a concave rack, by raking the straw over it, at the same time permitting the grain to pass through the interstices of the rack."

21. For improvements in the *Spark Arrester;* William P. McConnell, Washington, District of Columbia, December 10.

The smoke and sparks are to be drawn into a rotary fan blower, placed in the smoke-box, by which they are forced up a pipe, and then thrown into a reservoir of water placed above the smoke-box; the smoke and gases pass up through the openings of a perforated plate and out of the chimney, the draught of which is to be increased by the steam from the exhaust pipes. The water reservoir is provided with two pipes and cocks for discharging the water and cinders when desired, and it is also surrounded with a case of larger diameter, leaving a space between the two, and from this space tubes descend, so that the water and extinguished sparks which may be carried over the edge of the water reservoir, may descend and be discharged. We omit the claim, as it refers to the drawings, and could not be understood without them, but it is confined to the arrangements of the parts above described.

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22. For an improved vessel, or *Locomotive Steamer;* George Burnham, Philadelphia, Pennsylvania, December 10.

The patentee says:—"My vessel, or locomotive steamer, is to be rendered buoyant, and to be propelled by means of hollow, air-tight floats, in the form of drums, or spheriods, or spheres, which are to be of such capacity as to sustain the vessel and its load, without the dipping of any part of the hull, or body, of the vessel into the water, and without the submersion of any larger portion of such hollow floats than shall be compatible with their being advantageously used to carry buckets or paddles, for the purpose of propelling said vessel. These floats are to operate in water in a manner somewhat resembling that of the propelling wheels of locomotives on land; but they must, of course, be furnished with buckets, or paddles, to act upon the water in the manner of the ordinary paddle wheels of steamboats.

"I do not claim to be the first to have used buoyant cylinders, or floats, having paddles or buckets upon their peripheries; but what I do claim therein, and desire to secure by letters patent, is the using of revolving floats for obtaining buoyancy, and as propellers, in the manner herein set forth: that is to say, said floats being in diameter equal to that of the paddle wheels ordinarily employed, and like them, rising above the deck of the vessel, and being furnished with buckets, or paddles, the outer edges of which are to be on a line, or nearly so, with that of the peripheries of the floats."

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23. For an improvement in the machine for *Hulling Oats, Barley, &c.;* James Andrews and Enoch Piper, Camden, Waldo county, Maine, December 10.

This patent is for an improved mode of constructing the drum or disk of what is known as the "Scotch Barley Huller." The im-

proved machine consists simply of a stone disk, or short cylinder, revolving, with great velocity, within a case which revolves very slowly in the same direction. The disk is made of wood, covered with sheet iron, and studded with nails.

Claim.—"What we claim as our invention and improvement, is the manner of constructing the drum, or disk, of wood—sheathed with sheet iron, and armed with projecting nails, the same to revolve within a revolving case, or, in other words, that portion of the combination of a revolving drum or disk with a revolving case, so far as relates entirely to the manner of constructing the drum or disk, the whole being constructed and operating in the manner set forth."

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24. For an improved machine for *Cutting round Tenons;* Mahlon Gregg, Philadelphia, Pennsylvania, December 10.

The requisite guides and cutters are attached, by screws, to a face plate on a lathe. The screws which secure the guides pass through elongated holes or slots, so that they can be set to any sized tenon, and all at equal distances from the centre. One of the guides forms a part of a plate to which the cutters are attached, and the cutters are so formed as, when properly adjusted, to cut the surface of the tenon and the shoulder. They are fastened by a screw and staple, and their distance from the centre of the face plate may be regulated at pleasure.

Claim.—"What I claim as constituting my improvement, and desire to secure by letters patent, is the manner in which I have arranged and combined the face plate, and the adjustable cutter and guide pieces, so as to adapt the machine to the cutting of tenons and cylinders of different sizes."

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25. For improvements in the *Machine for Making Crackers;* Humphrey Winslow, Swansey, Massachusetts, December 14.

The dough is rolled to the proper thickness by sets of rollers in the usual manner, it is then carried under the cutters by a belt. The cutters are pressed down, and in rising, the dischargers, which occupy the space between the cutters, throw out the scraps upon the belt, which moves forward to present a fresh piece of dough; in the meantime a plate, called a conveyor, passes between the dough and the cutters, on to which the crackers are discharged by pistons working inside the cutters, and as this plate is withdrawn it is inclined, which causes the crackers to slide on to a board properly situated to receive them.

The claim refers throughout to the drawings.

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26. For machinery for *Manufacturing Felt Cloth;* Thomas R. Williams, an American Citizen now residing in London, England, December 14.

This apparatus consists of a combination of several machines employ-

continuously and consecutively, in the process of making cloth, :hout spinning or weaving, of wool, fur, or other animal fibre possing the quality of felting.

Γhe first machine is for forming the wool, &c., into a bat. It cons of a card, and two long belts which pass over rollers in opposite ections, so that the upper surface of the lower, shall be immediate-ınder the lower surface of the upper belt. These two belts receive the 'er from the doffer of the card, and it is wound on one of them :il a sufficient number of slivers have been wound on to make the . of the required thickness; the bat is then cut, and wound on a ler, and taken to the second or hardening machine. This harden-machine consists of two rows of rollers covered with cloth or other stic substance, one set immediately over the other; these are made :evolve slowly and the upper set receive a longitudinal vibratory tion. Between the lower set of rollers there are perforated pipes ough which steam, and dry heat, are applied to the bat, as it passes ween the rollers. The bat, thus partly felted, is taken to the last chine, which is composed of two sets of rollers operating like the 'dening machine, excepting that the upper set do not vibrate longi-inally—the two sets of rollers have an alternate reciprocating tion on their axes, the motion being greater in one direction than he other. The bat is placed in folds between two belts, and thus ses between the two sets of rollers, the lower set being partly im-rsed in suds.

]laim.—"I claim as my invention the different members of this ıbination collectively; as they are united and dependent on each er for producing a continuous and connected, or combined, result, t of the manufacture of commercial pieces or ends of cloth without ıning or weaving."

For an improved mode of *Constructing the Chain and Floor of Endless Chain Horse Powers* for driving machinery; Orestes Badger, Cooperstown, New York, December 14.

Γhe pieces constituting the floor, instead of being attached to a belt :o chains, are composed of plates of iron cast with a hook on the ler side, towards each end; and these when hooked together, by :s, constitute an endless chain. The upper surfaces of these plates cast with flanches, or ledges, to receive pieces of wood for the se to tread on. The rack which mashes into a cog wheel on the ft which conveys the power, is cast on the under side of the plates, as the chain passes over two polygons at each end, which would ›w the rack out of gear if made straight in the usual way, it is so as to consist of a series of arcs of circles—the teeth of which . always be in gear with the cog wheel, and thus correspond with rise and fall of the floor.

laim.—"I do not claim the formation of an endless floor machine ıat has been done by endless chains running over cog wheels with floor secured to said chains in various ways. But I do claim the structing an endless floor without an endless chain in the manner

proved machine consists simply of a stone disk, or short cylinder, volving, with great velocity, within a case which revolves very sl ly in the same direction. The disk is made of wood, covered w sheet iron, and studded with nails.

Claim.—"What we claim as our invention and improvement, is manner of constructing the drum, or disk, of wood—sheathed w sheet iron, and armed with projecting nails, the same to revolve w in a revolving case, or, in other words, that portion of the combi tion of a revolving drum or disk with a revolving case, so far as lates entirely to the manner of constructing the drum or disk, whole being constructed and operating in the manner set forth."

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24. For an improved machine for *Cutting round Tenons;* Mal Gregg, Philadelphia, Pennsylvania, December 10.

The requisite guides and cutters are attached, by screws, to a plate on a lathe. The screws which secure the guides pass thro elongated holes or slots, so that they can be set to any sized tenon, all at equal distances from the centre. One of the guides forms a of a plate to which the cutters are attached, and the cutters are formed as, when properly adjusted, to cut the surface of the tenon the shoulder. They are fastened by a screw and staple, and t distance from the centre of the face plate may be regulated at p sure.

Claim.—"What I claim as constituting my improvement, and sire to secure by letters patent, is the manner in which I have ranged and combined the face plate, and the adjustable cutter guide pieces, so as to adapt the machine to the cutting of tenons cylinders of different sizes."

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25. For improvements in the *Machine for Making Crackers;* H phrey Winslow, Swansey, Massachusetts, December 14.

The dough is rolled to the proper thickness by sets of roller the usual manner, it is then carried under the cutters by a belt. cutters are pressed down, and in rising, the dischargers, which occ the space between the cutters, throw out the scraps upon the which moves forward to present a fresh piece of dough; in the m time a plate, called a conveyor, passes between the dough and cutters, on to which the crackers are discharged by pistons wor inside the cutters, and as this plate is withdrawn it is inclined, w causes the crackers to slide on to a board properly situated to rec them.

The claim refers throughout to the drawings.

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26. For machinery for *Manufacturing Felt Cloth;* Thoma Williams, an American Citizen now residing in London, Engl December 14.

This apparatus consists of a combination of several machines em

ed continuously and consecutively, in the process of making cloth, without spinning or weaving, of wool, fur, or other animal fibre possessing the quality of felting.

The first machine is for forming the wool, &c., into a bat. It consists of a card, and two long belts which pass over rollers in opposite directions, so that the upper surface of the lower, shall be immediately under the lower surface of the upper belt. These two belts receive the sliver from the doffer of the card, and it is wound on one of them until a sufficient number of slivers have been wound on to make the bat of the required thickness; the bat is then cut, and wound on a roller, and taken to the second or hardening machine. This hardening machine consists of two rows of rollers covered with cloth or other elastic substance, one set immediately over the other; these are made to revolve slowly and the upper set receive a longitudinal vibratory motion. Between the lower set of rollers there are perforated pipes through which steam, and dry heat, are applied to the bat, as it passes between the rollers. The bat, thus partly felted, is taken to the last machine, which is composed of two sets of rollers operating like the hardening machine, excepting that the upper set do not vibrate longitudinally—the two sets of rollers have an alternate reciprocating motion on their axes, the motion being greater in one direction than in the other. The bat is placed in folds between two belts, and thus passes between the two sets of rollers, the lower set being partly immersed in suds.

Claim.—"I claim as my invention the different members of this combination collectively; as they are united and dependent on each other for producing a continuous and connected, or combined, result, that of the manufacture of commercial pieces or ends of cloth without spinning or weaving."

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27. For an improved mode of *Constructing the Chain and Floor of Endless Chain Horse Powers* for driving machinery; Orestes Badger, Cooperstown, New York, December 14.

The pieces constituting the floor, instead of being attached to a belt or to chains, are composed of plates of iron cast with a hook on the under side, towards each end; and these when hooked together, by links, constitute an endless chain. The upper surfaces of these plates are cast with flanches, or ledges, to receive pieces of wood for the horse to tread on. The rack which mashes into a cog wheel on the shaft which conveys the power, is cast on the under side of the plates, and as the chain passes over two polygons at each end, which would throw the rack out of gear if made straight in the usual way, it is cast so as to consist of a series of arcs of circles—the teeth of which will always be in gear with the cog wheel, and thus correspond with the rise and fall of the floor.

Claim.—" I do not claim the formation of an endless floor machine as that has been done by endless chains running over cog wheels with the floor secured to said chains in various ways. But I do claim the constructing an endless floor without an endless chain in the manner

above set forth, by means of hooks cast on the floor, and links connecting the floor plates together, in the manner set forth in the specification. I do also claim constructing the endless rack attached to the floor, composed of a series of arcs of circles, for the purpose and in the manner specified. And I also claim constructing the floor plates with dovetail flanches in order, cheaply and firmly, to secure the wooden plank upon the plates, so that the horse may travel more easily upon the wood than upon iron, and that being constructed and secured in that manner, the wooden plank can easily be taken out and replaced when worn."

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28. For a mode of *Propelling Boats by Jets of Water*; Hugh Ronalds, Albion, Illinois, December 14.

The propelling of boats by means of jets, or currents of water, has repeatedly been patented in Europe and in this country, under various modifications; in the present plan there are two cylinders lying horizontally in the vessel, and open at the stern. These cylinders are each provided with a piston impelled by a steam engine. The improvement claimed is to the making of the inner ends of the cylinders open to the atmosphere for the free egress and ingress of the air during the back and forward movement of the pistons, the water as it flows into said cylinders doing so by hydrostatic pressure only.

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29. For an improvement in the *Stump Extractor*; Eleazer Marble, Wyalusing, Bradford county, Pennsylvania, December 14.

An axle-tree, with a truck wheel and a swingle tree at each end, is jointed at its middle to a bar which is made fast to a stump of a tree, or other permanent body, by means of a chain. Two bars, perforated with holes from end to end, are jointed at one end to a clevis, made fast to the stump to be extracted, their other ends passing through a slot on each side of the middle of the axle-tree; the axletree is connected by means of a pin with either of the bars, alternately, and in such a manner as that the leverage can be increased at pleasure, by attaching it to the bar nearer the fulcrum. A horse, or horses, applied at each end of the axletree, pull in opposite directions.

Claim.—"What I claim is the combination of the perforated bars with the axle of the truck, perforated in the manner described, so as to allow of the bars being shifted to produce greater or less leverage —the axle being attached at its centre to the stump by a rod or other similar means, as described."

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30. For a mode of *Preventing Water from beating under Doors*; Alexander Kirkpatrick, city of Newark, New Jersey, December 14.

A kind of saddle is to be placed on a door sill, to catch and conduct off the water which beats under the door; this saddle is made with a groove running along under the door and communicating with basins which receive the water that runs into the groove, and which

is discharged through apertures along the outside edge. A tongue or fillet is let into the groove during dry weather to prevent dust from falling into it, and this is to be removed when rain is expected.

Claim.—"What I claim is the constructing of a saddle for door sills with a groove, basins, and apertures, as above specified, combined with the sill and door of dwelling houses and other buildings, either with or without the tongue, or with, or without the plate between the saddle and the sill, whether the same be effected exactly in the way herein described or in any other operating upon the same principle and producing similar results."

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31. For a machine for *Overhauling Cloth while Fulling;* John Tillou, city of New Haven, Connecticut, December 14.

The patentee says—"The design and object of my machine is to remove mill-wrinkles, and to make a smooth surface on cloth by means of a force so applied as to stretch the cloth widthwise, while the rolling cylinders passing the cloth, draw and stretch it lengthwise." "The principle is applicable to machinery for overhauling cloth while fulling, and for extending cloth while napping or shearing, or in lieu of revolving temples for weaving."

Two pairs of chains working over rollers and armed with rubbers, pass over and under the surface of the cloth at right angles to its length, the two nearly meeting in the middle of the cloth, and running in opposite directions, rub out the wrinkles—this is called the "transverse rubber." The cloth after leaving these chains passes between two sets of oblique rollers, the axis of one set forming an obtuse angle with the other, called "oblique stretchers," which stretch the cloth width-wise.

Claim.—"What I claim as my invention and desire to secure by letters patent is the transverse rubber and oblique stretchers, separately and in combination, for the purpose and in the manner described."

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32. For an apparatus for *Raising Water*, called the *Ælopile Hydraulic Apparatus;* Pierre Ravard, Paris, France, assigned to Eugene Ablon, of New York, December 17.

We make the following extract from the specification to give the reader a general idea of the principle on which this apparatus operates. The claim, which is of considerable length, makes reference throughout to the drawings.

"It is a well known fact that when steam is allowed to escape rapidly through a small orifice into the atmosphere, it carries with it a considerable portion of the surrounding air, and that the instrument denominated the ælopile has been, from this circumstance, proposed to be applied to the blowing of air into forges and furnaces. The same principle is also applied in the locomotive steam engine to create a partial vacuum in the furnace, by projecting a jet of waste steam up the chimney, which carries with it a large portion of air, thereby ef-

fecting the object desired. In my apparatus for raising water I apply the same principle to the producing of a partial vacuum in suitable receivers, into which water is then to be forced from the well, or other reservoir, by the pressure of the atmosphere."

The claim is to the combination and arrangement of the various parts of the apparatus with the view of applying the principle above indicated, to the raising of water.

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33. For an improvement in the manner of *Connecting the Piston Rod with the Pistons of Steam Cylinders,* of pumps, of blowing machines, and other engines in which the piston is to be double acting; Matthias W. Baldwin, Philadelphia, Pennsylvania, December 17.

The patentee says—"The object of my improvement is, by dispensing with the guides as commonly used, and with the pitman, or rod, usually employed, to connect the crank, or working beam, with the piston rod, and which in confined situations cannot be made of sufficient length to be advantageously employed, to combine the pitman and piston rod in one, by which the whole length of the piston rod is, in effect, added to the pitman. In carrying my improvement into effect, I connect the outer end of the piston rod, by means of a joint pin, directly to a crank, or to a vibrating beam, or lever, as the case may be; and the inner end thereof I likewise connect to the piston, by means of a joint pin, by which device the piston rod is allowed to vibrate laterally to that extent which may be necessary for the throw of the crank, or of the curve formed by the motion of the beam, or lever. In the upper, or outer, head of the cylinder I make a longitudinal slot, or opening, of sufficient length to admit of the lateral vibration of the piston rod, resulting from its mode of connexion, and this slot, or opening, I cover with a jointed hub, or with a slide, and connect the same with a stuffing box, to embrace the piston, constructing these parts in such manner as to keep them steam, water, and air tight, whilst the necessary freedom of motion is allowed."

"What I claim as my invention, and desire to secure by letters patent, is the attaching of the piston rod of a double acting steam, water, blowing, or other engine, directly to a lever beam, or crank, at one end, and to the piston at the other, causing the same piston rod to pass through a stuffing box connected with a jointed hub, or with a slide, so formed and arranged as to admit of the lateral vibration of the piston rod, substantially in the manner herein set forth."

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34. For improvements in the *Cooking Stove;* Jordan L. Mott, city of New York, December 17.

"The first improvement," the patentee observes, "consists in the employment of two cast iron, movable jambs, in combination with a tin reflector adapted thereto. The movable jambs consist of two plates of cast iron, in a triangular form, which, when roasting is to be effected in front of the fire, are received and retained in place by

means of suitable ledges on the hearth and front of the stove. The tin reflector used in combination with these jambs does not differ from other tin reflectors used for the same purpose, excepting in the giving to it that form which adapts it to the jambs, and to the "particular stove to which it is to be applied." "What I claim in this part of my improvement, is the combining with a cooking-stove of any of the kinds in which roasting is to be effected in front, two movable jambs, and a tin reflector, arranged and operating substantially as herein described."

"My second improvement consists in the manner of constructing, combining, and arranging a movable door, or shutter, which I denominate a fuel saver, and of adapting the stove thereto; which fuel saver is intended to produce a more perfect combustion of the fuel, and also to form a projecting shelf or hood over the fire, by the aid of which, when the coals are drawn out in front of the stove for the purpose of broiling, the fumes produced are effectually conducted into the fire-place. This movable door, shutter, or fuel saver, is hung upon hinges, but is capable of being lifted entirely out of its place in the front of the fire, so as to leave the whole of the fire-place completely open; it may also be raised up and sustained upon ledges, so as to inclose the upper portion of the fire-place, and to leave a passage under its lower edge for the free admission of air to the fire; it is likewise capable of being raised to a small height from the hearth, and made to incline forward for the purpose of drawing the ignited fuel towards the front, so as to occupy the opening left between its lower edge and the hearth; and when this has been done, it can be replaced without difficulty, and without disturbing the coal which has been raked forward; and, as before remarked, it may be removed from the front of the fire, and so placed as to constitute a shelf, or hood above it, by which the smoke and fumes from broiling, or other cooking operations, may be carried off into the fire-place." "What I claim as constituting my second improvement in cooking stoves, is the above fuel saver, door, or shutter, as constructed and combined with the hearth, front plate, and fire-place of a cooking stove of any kind to which it can be adapted, in the manner herein set forth, by which said door is rendered capable of being raised or lowered, inclined forward, or converted into a hood, or shelf, for the purpose and in the manner fully made known."

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35. For a process of *Tanning Hides and Skins*, by means of an apparatus adapted to that purpose; Daniel Howell, of New York City, Assignee of Walter Buchanan, December 17.

The apparatus described in this patent is simply a large wheel, the periphery of which is composed of rounds extending from head to head, revolving vertically in a tan vat, the sides of which, towards the top, flare outwards to catch the ooze that drips from the hides or skins as they are carried around by the wheel, to the respective rounds of which they are hung by their middles. The wheel is to be kept constantly turning, so that the hides or skins shall be alternately immersed in, and removed from, the tanning liquor.

Claim.—"What I claim as my invention is the tanning of hides and skins, by attaching them to, or hanging them by the slats or rounds of, a wheel, such as is herein described; said wheel being placed over a tan vat, in such a manner as that by its revolution, the skins shall be alternately dipped into and raised from the tanning liquor by a motion which is to be continuous, or nearly so, during the process. Not intending, however, by the foregoing claim, to limit myself to the precise form of the apparatus as herein described, but holding myself at liberty to vary the same as I may think proper, whilst I attain the same end by means substantially the same."

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36. For an improvement in the *Truss, for the cure or relief of Prolapsus Uteri, Hernia, &c.;* Goodown Bright, Bellbrook, Greene county, Ohio, December 17.

The following extract from the specification, together with the claim, will afford a tolerably clear idea of the improvements, viz:—"My improvements consist mainly in the manner in which I combine two elastic springs and back pads, with an abdominal pad; and in the manner in which I construct and combine with said abdominal pad a bifurcated steel spring, which I usually form of wire, and which sustains a perinæal pad, whilst it leaves the urinary passage unobstructed." "What I claim and desire to secure by letters patent, is the manner of attaching to the abdominal pad an elastic bifurcated wire or steel spring, carrying a perinæal pad, the same being constructed, and operating in the manner and for the purpose made known."

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37. For improvements in the *Apparatus for Manufacturing Pipes of Lead;* George Escol Sellers, Township of Upper Darby, Delaware county, Pennsylvania, December 17.

The first improvement claimed in this patent is for the forcing of the molten lead from the melting pot, through the dies that are to form the pipe. The pressure of air is applied to the surface of the lead by means of a forcing pump, the air being heated on its way to the pot by passing through a tube coiled around its outside, and within the flue of the furnace.

The second improvement is in the manner of cooling the nozzle, or former, by the circulation of cold water around it, this being effected by forcing a stream of that fluid through a pipe coiled around said nozzle, or former, within which there is a mandrel, or core, which forms the bore of the pipe.

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38. For an improvement in the machine for *Spinning Silk;* George Heritage, Chestertown, Kent county, Maryland, December 19.

This machine is for spinning silk directly from the cocoons, and giving the necessary twist to it at the same time. The cocoons are placed in revolving pans, (for a description of which the reader is referred to the notice of the patent next following) which give the first twist to the strands; the threads are then guided to two square

shafts, around which they pass, the axles of which are parallel; these are divided into sections of different diameters, for the purpose of drawing the threads from the cocoons with different degrees of velocity, to give different degrees of fineness and twist; the threads pass thence to the flyers and spindles, which are of the usual construction.

Claim—"What I claim, is the combining of the revolving basins, or vessels, in which the cocoons are contained, with the apparatus for spinning the same into thread; the single strands receiving their twist from the revolution of the basins, and these being doubled and twisted by the spinning apparatus, the whole being arranged and combined substantially in the manner herein set forth. I also claim the use of the graduated square, or triangular, shafts, for the purpose of holding the strands and unwinding the silk from the cocoons with different velocities, in the manner and with the intention herein described."

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39. For an improvement in the machinery for *Reeling Silk from the Cocoons;* George Heritage, Chestertown, Kent county, Maryland, December 19.

It is observed in the specification, that "in the ordinary mode of reeling silk from the cocoons, and forming from it what is known under the name of raw silk; the fibres from the respective cocoons form a flat, angular, or irregular thread, as they do not receive any twist on their way to the reel from the basin or vessel containing them. By my improved machinery, I cause the respective fibres which are to form one thread, to twist together, as the cocoons are unwound, and in consequence of such twisting to form a round thread when wound upon the reel, which round thread is much better adapted to various uses in the silk manufacture, than the raw silk as heretofore formed." To effect this, the basin in which the cocoons are placed is attached to a spindle with which it revolves, and the basin is divided into compartments, so that the water contained in it, with the cocoons, revolve with it, and give the desired twist.

Claim.—"What I claim as my invention is, the giving to the threads of raw silk, in the operation of reeling the same from the cocoons, such a degree of twist as may be desired, by giving a revolving motion to the basins, or vessels, in which said cocoons are contained, the same being effected by an apparatus constructed in the manner herein set forth."

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40. For improvements in the *Cooking Stove;* William Melsheimer, city of Philadelphia, Pennsylvania, December 19.

This stove has four ovens; two of these are at the ends of the grate, or fire chamber. These are necessarily shallow, but boilers may be so constructed as to be placed in part within them. There is a third oven immediately behind the fire chamber, and above this is the fourth oven, which stands above what is ordinarily the top plate of the stove. This oven projects in part over the fire chamber, and is surrounded on four sides by flues. The lower flue passes over the top of the oven which is behind the fire chamber, said oven receiving its heat from

this flue, and from the back plate of the fire chamber. The whole is to operate without dampers, the heat and draught being regulated by the different capacities of the flues.

Claim.—"What I claim, and desire to secure by letters patent, is the manner in which I have arranged and combined the four ovens; one at each end of the fire chamber; one immediately behind the fire chamber, with a flue passing over the top of it only; and the fourth or principal oven situated immediately above this, and extending in part over the fire chamber, as set forth." "I also claim the manner of graduating and arranging these flues, so as to render their regulation by dampers unnecessary when the oven is to be heated; said graduation and arrangement being substantially the same with that herein made known."

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41. For improvements in the *Spark Arrester;* Leonard Phleger, Philadelphia, Pennsylvania, December 28.

This patent is for improvements on the spark arrester, patented by Mr. Phleger on the 10th of September, 1840, and noticed in this Journal vol. ii, page 337; to which the reader is referred. The first improvement is in substituting for the elbow pipes extending from the bottom to the top of the outer case, in the former patent, openings near the top and bottom of said case, and then adding a jacket outside of the whole. The second improvement is in dispensing with the perforated cone of metal, and substituting a conical, or cylindrical, tube perforated with large holes near the top and bottom, through which the draught, sparks, &c., pass into the space between this, and what constitutes the outer case, as described in former patent; and in adding a cap over the space with a flanch extending down a little below the top of, and of greater diameter than, the outer case, by which the draught, &c. is carried to the space between this outer case and the jacket outside of it, as above mentioned.

The claim is confined to these two improvements.

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42. For improvements in the *Cooking Stove;* Joel Greene, Rochester, Monroe county, New York, December 28.

This is a modification of that kind of stoves in which the fire chamber is above the oven. The side plates of the fire chamber extend up to within a short distance of the top plate, which is pierced to receive boilers, &c., and form, with the side plates of the stove, the side flues, the side plates of the oven being immediately under the side plates of the fire chamber. The bottom plate of the fire chamber forms the top of the oven, and extends through the side flues, and is there perforated with square holes, provided with registers to regulate, or stop, the draught, and prevent its circulation around the oven. The oven extends from the front to the back plate, and in the back of the side flues there are flues called angle flues, formed to conduct the draught to the funnel, or pipe, at the back. There is an opening leading from the back of the fire chamber directly into the pipe, or funnel,

governed, as usual, by a damper. Between the bottom plate of the oven and the bottom of the stove, are arranged oblique plates to conduct the draught in various directions under the oven.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the side flues in combination with the angle flues and funnel as before described. Likewise the arrangement of the register for governing the draught, in combination with the oblique plates under the oven, as described."

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43. For an improvement in *Wind Mills;* Isaac Garver and Samuel Fahrney, Washington county, Maryland, December 28.

This patent is for a mode of setting and shifting the sails of wind mills. The backs of the sails are jointed to the arms, and a rod, attached to the back of each sail, is connected with a thimble on the shaft, by sliding which, the angle of the sails is changed. The sails are kept at their greatest angle by a spring, the end of which is forked and fits into a groove made for that purpose in the thimble. A cord attached to the thimble passes over pullies and down to within reach of the operator, by means of which the tension of the spring can be overcome, and the sails shifted.

The claim is to the "arrangement of the rods attached to the back of the sails and to the rim of the thimble, and in combination therewith a spring for keeping the sails in an extended position, instead of cords and weights, which have been used."

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44. For a *Fire Alarm;* Rufus Porter, Bellerica, Middlesex county, Massachusetts, December 28.

The apparatus described in this specification, is for giving notice of fire in a building by the expansion of a bent bar of metal, the ends of which are made fast to the bottom of the case of the alarm, and its middle connected by a rod and hook with a trigger which holds the hammer of the bell. The expansion of the bent bar, which is held by both ends, increases the curvature and thus pulls the trigger.

The patentee disclaims the invention of applying the expansion of a bar of metal by heat, to disengage, or liberate an alarm, and limits his claim to the combination of the bar of metal with the parts constituting the catch and trigger, and with the hammer of the bell; and also the arrangement of parts constituting the escapement for working the hammer, a description of which we omit, as it could not well be understood without drawings.

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45. For improvements in *Rail Ways, and in the mode of applying power to propel carriages thereon;* John Rangeley, Camberwell, England, December 28; patent to run 14 years from March 3, 1840.

The claim on which this patent was granted will give a good general idea of the principle of the invention, viz: "The nature of my invention, and the best manner I am acquainted with of performing the same, having been thus described, I declare that I lay no claim to

the various parts separately, nor do I confine myself to any precise arrangement of the details, so long as the peculiarity of my invention be retained; and, although I have spoken of the steam engine, which I consider will be the best motive power, in most cases, I do not confine myself thereto, as other power may be employed. But what I claim, is the mode herein described of constructing railways, whereby the power employed to propel carriages thereon is transmitted by a series, or train, of wheels, revolving on axles supported on stationary bearings fixed in the line of rail way, and in such manner that the carriages for passengers and goods are caused to pass over and be acted on, and moved by, the rotary motion of such wheels, by the contact and friction of their peripheries acting against the undersides of the pair of running rails attached to each carriage, the wheels being driven by endless bands leading from the moving power."

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46. For an improvement in *Gudgeons, and in the mode of securing them to shafts, &c.;* David Philips, Georgetown, Mercer county, Pennsylvania, December 28.

"The nature of this improvement consists in making the gudgeon with wings radiating from its periphery, and with notched arms projecting from said wings nearly at right angles and in an opposite direction from that of the gudgeon, which arms and wings are let into the shaft in channels made therein; the wings being let into the ends, and the arms into the sides of the shaft, which arms are secured by keys let into cross grooves in the shaft, and driven into the notches of the arms, which draw the gudgeon firmly against the ends of the shaft, and which are farther secured by bands passed over the arms and shaft." "What I claim as my invention, is the mode of attaching and securing the gudgeon to the shaft by means of the notched arms and key, as described."

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47. For a *Cooking Closet*; Joshua Grime, Beekmantown, Westchester county, New York, December 28.

An iron closet, with doors, and bars extending across to receive sheets or plates of metal, is built in the jambs of a chimney. A fire chamber is built in the bottom, with an ash receiver and draught hole, and over this fire chamber is a tube extending to the top, the lower end being funnel shaped, to receive and conduct off the smoke, &c. to the flue. There is an opening at top leading into the flue of the chimney, and governed by a damper, for the purpose of heating the closet in the manner in which ovens are heated. The various articles to be cooked and baked are placed on the shelves or plates, and the doors are then shut to confine the heat.

The claim is to the "combination of a chimney flue or other convenient means to create draught and carry off the smoke, gas, &c., with a closet constructed with the draught hole, fire chamber, and the opening and damper at top."

48. For an improvement in the *Coffee Roaster;* Abel Stillman, Poland, Herkimer county, New York, December 28.

This roaster consists of a sheet iron cylinder, hung on gudgeons, which have their bearings in a plate made to fit the boiler hole of a cooking stove, so as to expose the surface of the cylinder itself, when revolving, to the direct action of the heat. There is a hole made in the end of the cylinder, covered with mica, through which to see, when the coffee is sufficiently roasted.

Claim.—"I do not claim as my invention the combination of a cylinder for roasting coffee, with a vessel adapted to the boiler openings of a stove; said vessel having a bottom to it so as to exclude the fire from the heater; but what I claim, is combining the coffee roaster with a rim or vessel, open below, so as to admit the fire to the roaster, and adapted to the stove, portable furnace, or fire place as herein set forth, and the insertion of a piece of mica or other transparent substance in the end of the cylinder."

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49. For an improvement in the *Spark Arrester;* David Matthew, Schenectady, New York, December 31.

To the top of the chimney is attached a plate with a hole in the middle, larger than the diameter of the chimney, and to this is attached a short conical pipe. The outer edge of this plate is connected with another plate, about fifteen inches above it, by a wire gauze, and the upper plate is provided with an inverted cone, placed immediately over the chimney. The lower plate, first mentioned, is pierced with five holes, surrounded by conical pipes extending down a short distance, to conduct the sparks into the space between the chimney and the outer casing. The smoke, sparks, &c., pass up the chimney, strike against the cone, and are turned off, the sparks falling through the small conical tubes in the lower plate into the space between the chimney and the outer casing, and the smoke, gas, &c., pass through the wire gauze and then out at the top, between the wire gauze and the outer casing. The claim is confined to the combination of the two plates, constructed in the manner described, having a wire gauze arranged between them, with the casing surrounding the chimney of the locomotive in the form as above set forth.

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50. For improvements in the manner of constructing *Locomotive Steam Engines;* Matthias W. Baldwin, Philadelphia, Pennsylvania, December 31.

"My improvement consists in a new mode of arranging the gearing and general connexion of the driving and truck wheels, in which arrangement the connecting axle is retained in its place, in part by being confined to the engine frame, and in part by the truck frame, in consequence of the particular manner in which I construct said frame." The intermediate axle, which lies between the two axles of the truck wheels, is driven by shackle bars from the driving wheels.

It is connected with the main frame of the engine by two rods that admit of its playing up and down, whilst its relative distance from the axle of the driving wheels is preserved. The boxes, in which this intermediate axle has its end bearings, play in guide frames attached to the truck frame, so that the truck frame and wheels can play without affecting the position of the intermediate axle; the axles of the truck wheels receive motion from the intermediate shaft by cogged wheels on them, attached to the middle of their length, the cogs being so formed as to admit of the play.

"My next improvement," says the patentee, "consists in the so placing of the springs of the truck as to obviate the evil of the locking of the wheels when the truck frame vibrates from the centre pin, vertically, to which they are liable when the springs are placed at the sides, in the usual manner. Instead of attaching them at the sides, I place them at each end of the truck frame. I have also improved the manner of constructing the iron frames of the locomotives, by making the pedestals in one piece with, and constituting a part of, said frame. I have also invented and adapted a new manner of stuffing, or packing, by substituting metallic wire for hemp, cotton, or other fibrous materials, hitherto used for that purpose, by which means I insure a durability greatly transcending the ordinary stuffing, and find the action of this substance to possess all the properties desirable in stuffing, either around the stems of valves, in stuffing boxes, or in other parts of the apparatus where stuffing is required."

Claim.—"I claim the manner of combining and arranging the connecting axle placed intermediately between the truck wheels, and passing through guide boxes attached to the truck frame, substantially as set forth; whilst at the same time, the parallelism of the said connecting axle of the driving wheels is maintained by the means herein described, or by arrangements similar thereto in their nature and results, by which arrangement and combination of parts the connecting axle has a free vibration vertically with the truck frame, whilst the truck frame is also free to vibrate horizontally." "I claim substituting a metallic stuffing, consisting of wire, instead of cotton, hemp, wool, or the other fibrous materials ordinarily employed, whether the same be used around the stems of valves, in stuffing boxes, or in other situations where such packing is required." "I claim the combining of spiral springs with the cylindrical boxes and pedestals for the wheels of locomotive cars, &c., constructed and arranged as herein set forth."

[TO BE CONTINUED.]

	Baro									Hygrometer.					
Co	9, P. M.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	30.01	5	$\frac{1}{3}$	2	$\frac{2}{3}$	$4\frac{2}{3}$	1	.	3	....	.	......	....	..	1545
2															
3	30.00	$12\frac{1}{3}$	$\frac{2}{3}$	$1\frac{1}{3}$	.	$8\frac{1}{3}$	.	.	$2\frac{1}{3}$	....	.	......	....	..	1537
4															
5															
6	29.57	$6\frac{2}{3}$	.	$6\frac{2}{3}$	.	$2\frac{1}{3}$	.	.	$9\frac{1}{3}$	....	.	......	....	..	1545
7															
8															
9	28.13	$6\frac{1}{3}$	.	$12\frac{1}{3}$	.	8	.	.	.	....	.	......	....	..	1576
10															
11	29.32	$2\frac{2}{3}$	.	$6\frac{2}{3}$	.	$1\frac{1}{3}$	.	15	2	....	.	......	....	..	1548
12															
13															
14	29.46	$6\frac{2}{3}$	$1\frac{1}{3}$	2	$1\frac{1}{3}$	$\frac{2}{3}$	.	1	10	59.50	1	......	71.00	1	1553
15	29.54	$4\frac{2}{3}$	$2\frac{2}{3}$	3	1	$3\frac{2}{3}$	$2\frac{2}{3}$	.	.	59.52	.	......	68.19	.	1554
16															
17															
18	29.71	$8\frac{2}{3}$	.	13	.	$4\frac{1}{3}$	.	.	1	....	.	......	....	..	1536
19	29.51	1	.	$4\frac{2}{3}$	.	$2\frac{2}{3}$	.	$3\frac{2}{3}$	$\frac{1}{3}$	....	.	......	71.00	..	1541
20															
21															
22															
23															
24															
25															
26	29.46	2	.	$1\frac{1}{3}$	.	$3\frac{1}{3}$	.	$17\frac{2}{3}$	4	....	.	.....	....	..	1540
27															
28															
29	29.40	$4\frac{2}{3}$	$1\frac{2}{3}$	$1\frac{2}{3}$	$\frac{1}{3}$	1	$1\frac{2}{3}$	$5\frac{1}{3}$	.	59.75	16	......	66.25	16	1560
30															
31	29.39	.	.	$22\frac{1}{3}$	.	.	.	.	2	....	.	......	....	..	1557
32	29.27	$2\frac{1}{3}$	$1\frac{2}{3}$	$2\frac{2}{3}$	$\frac{1}{3}$	$1\frac{2}{3}$	$\frac{1}{3}$	1	$16\frac{1}{3}$	....	.	......	....	..	1551
33															
34	......	$4\frac{2}{3}$	$\frac{2}{3}$	14	.	4	$\frac{1}{3}$	.	$1\frac{2}{3}$	....	.	.....	....	..	1555
35															
36	28.00	6	.	9	$\frac{1}{3}$	5	.	$3\frac{1}{3}$	$3\frac{1}{3}$	....	.	.....	....	..	1549
37	29.25	$5\frac{2}{3}$	5	$\frac{1}{3}$	$12\frac{1}{3}$	5	.	.	$\frac{2}{3}$	....	.	.. .	....	..	1539
38	27.93	$4\frac{1}{3}$	.	2	$1\frac{1}{3}$	$2\frac{2}{3}$	.	$11\frac{2}{3}$	$6\frac{2}{3}$	....	.	.....	75.07	11	1543
39	28.80	5	.	17	.	.	.	$7\frac{1}{3}$	.	....	.	......	....	..	1636
40															
41															
42	28.98	1	.	.	.	$20\frac{1}{3}$	.	.	$8\frac{2}{3}$	....	.	.....	....	..	1556
43															
44															
45	29.07	$9\frac{2}{3}$	.	$6\frac{2}{3}$	.	5	.	$5\frac{2}{3}$	.	....	.	......	....	..	1606
46															
47															
48	29.27	$2\frac{1}{3}$	.	2	$\frac{2}{3}$	$7\frac{2}{3}$	$\frac{1}{3}$	$7\frac{2}{3}$	2	....	.	......	....	..	1552
49	29.39	3	.	1	.	$16\frac{1}{3}$	.	$6\frac{2}{3}$	$1\frac{1}{3}$	....	.	......	....	..	1589
50	28.89	3	.	18	.	$1\frac{2}{3}$	.	.	.	....	.	......	....	..	1544
51															
52	28.73	$\frac{2}{3}$	.	$1\frac{1}{3}$	.	1	.	$14\frac{2}{3}$	$1\frac{2}{3}$	....	.	......	....	..	1542
53	29.43	$4\frac{1}{3}$	$1\frac{1}{3}$	$7\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$1\frac{2}{3}$	$3\frac{1}{3}$	.	....	.	......	....	..	1680

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JULY, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia.	Philadelphia,	E. W. Hamilton.	72.15	82.63	73.58	97.00	60.50	76.12	5	53.00	63.24	2
2 Montgomery.												
3 Bucks.	Newtown,	L. H. Parsons,	68.30	77.84	66.29	90.50	57.00	70.81	⅓	50.00	60.27	1
4 Lehigh.												
5 Northampton.												
6 Monroe	Stroudsburg,	A. M. Stokes,	67.73	84.83	69.00	94.00	50.00	73.89	12⅓	......	......	.
7 Pike.												
8 Wayne.												
9 Susquehanna.	Silver Lake,	E. Rose,	66.22	80.00	72.25	93.00	57.00	72.82	.	57.00	63.22	.
10 Luzerne.												
11 Schuylkill,	Port Carbon	P. C. Lyceum,	65.39	86.67	63.77	100.00	52.00	71.94	2⅓	36.00	47.80	6
12 Berks.												
13 Chester.												
14 Delaware.	Haverford,	Haverford School,	72.13	77.10	74.35	87.50	62.00	74.52	⅓	61.00	60.03	1
15 Lancaster,	Lancaster,	Conservatory of Arts,	68.74	82.26	76.37	92.50	60.00	75.79	.	55.00	65.61	.
16 York.												
17 Lebanon.												
18 Dauphin.	Harrisburg,	J. Heisely,	72.53	81.90	77.13	91.00	65.00	77.19	1	59.00	69.06	.
19 Northumberland.	Northumberland,	Andrew C. Huston,	70.00	78.00	72.32	91.00	64.00	73.44	.	47.00	61.19	.
20 Columbia.												
21 Bradford.												
22 Tioga,												
23 Lycoming,												
24 Union.												
25 Mifflin.												
26 Juniata,	Mifflintown,	J. A. Kinkead,	61.52	80.18	68.31	92.00	48.00	70.00	3⅔	......	......	.
27 Perry,												
28 Cumberland,												
29 Adams.	Gettysburg,	Prof. M. Jacobs,	68.48	83.02	70.47	93.00	61.00	73.99	.	54.00	62.10	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	68.16	86.40	70.03	98.00	56.00	74.86	2	......	......	.
32 Centre,	Bellefonte,	John Harris,	66.21	83.96	71.00	95.00	52.00	78.72	10⅓	......	......	.
33 Potter,												
34 M'Kean.	Smithport,	M. R. Atkins,	60.19	76.61	65.16	90.00	49.00	67.32	.	41.00	53.35	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	62.30	80.00	63.29	96.00	47.00	68.53	1⅔	42.00	55.77	1
37 Bedford.	Bedford,	Samuel Brown,	67.16	82.89	70.85	95.00	54.50	73.63	⅔	......	......	.
38 Somerset,	Somerset,	George Mowry,	64.93	76.29	63.92	85.00	54.00	68.38	6⅔	45.00	57.10	2
39 Indiana,	Indiana,	Richard White,	75.39	84.39	66.39	98.00	50.00	75.39	.	40.00	53.35	5
40 Jefferson,												
41 Warren,												
42 Venango,	Franklin,	Wm. Connely,	65.46	79.05	72.78	90.00	54.00	72.43	8	......	......	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weethee,	68.77	84.39	68.58	96.00	55.00	73.91	.	......	......	.
46 Green,												
47 Washington,												
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	72.11	77.31	74.83	98.00	61.00	74.75	2⅔	50.00	62.97	1
49 Beaver,	Beaver,	James Allison,	69.74	83.73	68.27	95.00	59.00	73.91	⅔	48.00	59.39	.
50 Butler,	Butler,	Jacob Mechling,	65.90	79.81	72.21	91.00	56.00	72.64	.	......	......	.
51 Mercer,												
52 Crawford,	Meadville,	Henry Shippen,	70.13	75.84	72.61	86.00	62.00	72.86	.	46.00	56.68	.
53 Erie,	Erie,	James C. Reid,	67.29	74.10	68.71	86.00	57.00	70.03	⅓	......	......	.

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia.	30.02	29.99	30.01	30.36	29.59	30.01	3⅓	19⅔	7	4	2	....	....	4	3.228
3 Bucks.	30.03	30.00	30.00	30.37	29.78	30.01	⅓	17⅓	12	1⅔	7	....	....	3	4.400
6 Monroe	29.61	29.63	29.57	29.98	29.40	29.60	9⅔	14⅓	5⅓	11⅓	4	....	....	1	5.250
9 Susquehanna.	28.13	28.14	28.13	28.33	27.83	28.13	.	17⅓	13⅔	.	7	....	....	....	2.070
11 Schuylkill,	29.33	29.35	29.32	29.63	29.13	29.33	2⅓	21⅔	7	2⅓	3	....	....	3	3.657
14 Delaware.	29.49	29.45	29.46	29.84	29.23	29.47	⅓	20	10⅔	⅓	4	....	....	....	1.975
15 Lancaster,	29.54	29.53	29.54	29.85	29.27	29.54	.	21	10	.	5	....	....	2	1.430
18 Dauphin.	29.74	29.69	29.71	30.01	29.51	29.71	.	.	.	.	1	....	....	5	2.046
19 Northumberland.	29.53	29.51	29.51	29.84	29.29	29.52	.	11⅔	19⅓	.	7	....	....	4	2.546
26 Juniata,	29.49	29.45	29.46	29.80	29.25	29.47	4	18⅔	8⅔	3⅔	1	....	....	1	1.180
29 Adams.	29.41	29.41	29.40	29.69	29.17	29.40	.	22⅓	8⅔	.	7	....	....	....	2.620
31 Huntingdon,	29.42	29.40	29.39	29.68	29.18	29.40	2	25	6	.	7	....	....	....	0.976
32 Centre,	29.31	29.28	29.27	29.59	29.07	29.29	11⅓	12	5⅔	13⅓	2	....	....	1	4.740
34 M'Kean.	......	......	......	......	......	......	.	23⅔	7⅓	.	5	....	....	4	2.260
36 Cambria,	28.00	28.00	28.00	28.27	27.76	28.00	1⅔	11⅔	17	2⅓	2	....	....	5	2.857
37 Bedford.	29.27	29.27	29.25	29.55	29.03	29.27	⅔	18	12⅓	⅔	....	....	....	....	......
38 Somerset,	27.91	27.93	27.93	28.12	27.70	27.92	6⅔	10⅔	13⅓	6⅔	3	....	....	3	2.431
39 Indiana,	28.80	28.80	28.80	29.10	28.50	28.80	.	22⅔	8⅓	.	6	....	....	....	2.040
42 Venango,	29.02	29.01	28.98	29.30	28.78	29.00	8⅓	.	.	.	....	....	....	....	......
45 Fayette,	29.07	29.07	29.07	29.24	28.60	29.07	.	26	4⅔	⅓	....	....	....	....	......
48 Alleghany,	29.30	29.27	29.27	29.48	29.04	29.28	2⅓	13⅔	15⅓	2	3	....	....	3	3.456
49 Beaver,	29.47	29.42	29.39	29.66	29.00	29.43	⅔	17⅔	12⅓	1	4	....	....	1	1.280
50 Butler,	28.88	28.89	28.89	29.10	28.65	28.89	.	.	.	.	....	....	....	3	1.578
52 Crawford,	28.74	28.72	28.73	29.01	28.55	28.73	.	18	12	1	10	....	....	1	3.430
53 Erie,	29.46	29.46	29.43	29.70	29.20	29.45	⅓	23	7⅔	⅓	8	....	....	....	4.312

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia.	2⅔	1⅔	1	.	⅓	.	⅓	⅓	4⅓	3⅔	5	⅓	2	⅔	4⅔	1	.	3	....	.	......	....	.	1545
3 Bucks.	.	⅓	2⅓	.	.	.	2	⅓	1	.	12⅓	⅔	1⅓	.	8⅓	.	.	2⅓	....	.	......	....	..	1537
6 Monroe	1⅓	.	1⅓	.	⅔	.	⅔	.	1⅓	.	6⅔	.	6⅔	.	2⅓	.	.	9⅓	....	.	......	....	..	1545
9 Susquehanna.	2	.	.	.	.	.	.	.	2⅓	.	6⅓	.	12⅓	.	8	.	.	.	....	.	......	....	..	1575
11 Schuylkill,	⅓	.	⅓	.	1⅔	.	1	.	.	.	2⅔	.	6⅔	.	1⅓	.	15	2	....	.	......	....	..	1548
14 Delaware.	3⅔	⅔	.	1	⅓	.	.	.	⅔	1⅔	6⅔	1⅓	2	1⅓	⅔	.	1	10	59.50	1	......	71.00	1	1552
15 Lancaster,	3	1	1⅔	⅓	⅓	⅓	1	⅔	3⅓	1⅔	4⅓	2⅔	3	1	3⅓	2⅔	.	.	59.52	.	......	58.19	.	1554
18 Dauphin.	2⅔	.	.	.	.	.	1	.	⅓	.	8⅓	.	13	.	4⅓	.	.	1	....	.	......	....	..	1526
19 Northumberland.	5⅔	⅓	2	.	⅔	.	3⅔	⅓	6⅓	.	1	.	4⅔	.	2⅓	.	3⅔	⅓	....	.	......	71.00	..	1541
26 Juniata,	.	.	⅓	.	⅔	.	2	.	.	.	2	.	1⅓	.	3⅓	.	17⅔	4	....	.	......	....	..	1540
29 Adams.	4	.	1⅓	.	.	.	⅔	1	5⅓	2⅓	4⅔	1⅔	1⅔	⅓	1	1⅔	5⅓	.	59.75	15	......	56.25	15	1560
31 Huntingdon,	.	.	.	.	6⅔	.	.	.	.	.	.	.	22⅓	.	.	.	.	2	....	.	......	....	..	1557
32 Centre,	1⅓	.	1⅓	.	.	.	⅓	⅓	1⅓	.	2⅓	1⅔	2⅔	⅓	1⅔	⅓	1	16⅓	....	.	......	....	..	1551
34 M'Kean.	⅓	.	1⅔	.	1⅓	.	1⅓	.	1	⅓	4⅔	⅔	14	.	4	⅓	.	1⅔	....	.	......	....	..	1555
36 Cambria,	1⅔	.	.	.	.	.	1⅓	.	1	.	6	.	9	⅓	5	.	3⅓	3⅓	....	.	......	...	..	1549
37 Bedford.	.	.	.	.	.	1⅓	.	.	⅔	.	5⅔	5	⅓	12⅓	5	.	.	⅔	....	.	.. .	....	..	1525
38 Somerset,	⅓	.	⅓	.	.	.	⅔	⅓	⅓	.	4⅓	.	2	1⅓	2⅔	.	11⅔	6⅔	....	.	......	75.37	11	1542
39 Indiana,	.	.	.	.	.	.	⅔	.	1	.	5	.	17	.	.	.	7⅓	.	....	.	......	....	..	1536
42 Venango,	.	.	.	.	.	.	1	.	.	.	1	.	.	.	20⅓	.	.	8⅔	....	.	......	....	..	1558
45 Fayette,	1	.	1⅓	.	.	.	1	.	⅔	.	9⅔	.	6⅔	.	5	.	5⅔	.	....	.	......	..		1566
48 Alleghany,	.	.	⅔	⅓	.	.	1⅓	.	.	.	2⅓	.	2	⅔	7⅔	⅓	7⅔	2	....	.	......	....		1552
49 Beaver,	.	.	⅓	.	.	.	2	.	.	⅔	3	.	1	.	16⅓	.	6⅔	1⅓	....	.	......	...	..	1539
50 Butler,	.	.	⅓	.	7⅔	.	.	.	⅓	.	3	.	18	.	1⅓	.	.	.	....	.	...	....	..	1544
52 Crawford,	4	.	1⅔	.	5	.	⅓	.	3	.	⅓	.	1⅓	.	1	.	14⅔	1⅔	....	.	...	....		1542
53 Erie,	3	2⅓	5	.	.	.	⅓	.	1⅓	.	4⅓	1⅓	7⅓	⅓	⅓	1⅓	3⅓	.	....			...		[illegible]

	M	Collate ology. vani	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1	Phi															
2	Mor															
3	Buc		$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	3	$\frac{1}{3}$	.	2	....	.	.....	....	..	1559
4	Leh															
5	Nor															
6	Mor															
7	Pike															
8	Way															
9	Sus		$\frac{1}{3}$	.	13	.	$5\frac{1}{3}$	.	.	.	....	.	.....	....	..	1572
10	Luz															
11	Schu															
12	Berk															
13	Che.															
14	Dela			$1\frac{2}{3}$	$1\frac{2}{3}$	$\frac{1}{3}$	2	$\frac{1}{3}$	$2\frac{1}{3}$	$2\frac{1}{3}$	54.84	.	.....	73.23	..	1564
15	Lanc			$1\frac{2}{3}$	$1\frac{1}{2}$	.	1	2	.	$\frac{1}{3}$	62.96	1	.....	68.63	1	1578
16	York															
17	Leba															
18	Daug		$\frac{2}{3}$	.	10	.	.	.	.	1	....	.	.....	....	..	1558
19	Nort		$\frac{2}{3}$	.	6	$\frac{1}{3}$	$2\frac{2}{3}$	.	$3\frac{2}{3}$	.	....	.	.....	70.00	..	1562
20	Colu															
21	Brad															
22	Tiog															
23	Lyco															
24	Unio															
25	Miffl															
26	Juni		$1\frac{1}{3}$	.	.	.	1	.	19	$4\frac{1}{3}$	....	.	.....	....	..	1563
27	Perr															
28	Cum															
29	Adar		$1\frac{2}{3}$	.	$\frac{2}{3}$	.	$\frac{2}{3}$	$\frac{1}{3}$	$8\frac{1}{3}$	.	60.84	1	.....	67.22	1	1574
30	Fran															
31	Hun		.	.	$20\frac{2}{3}$	1	.	.	.	.	....	.	.....	....	..	1579
32	Cent		3	$1\frac{1}{3}$	$4\frac{1}{3}$	.	3	.	2	$5\frac{2}{3}$	....	.	.....	....	..	1565
33	Potte															
34	M'K		$3\frac{2}{3}$	2	$6\frac{1}{3}$	1	$1\frac{1}{3}$	.	$\frac{2}{3}$	.	....	.	.....	....	..	1575
35	Clear															
36	Cam		$3\frac{2}{3}$	.	6	.	$1\frac{2}{3}$	.	$8\frac{1}{3}$	$2\frac{1}{3}$	....	.	.....	....	..	1570
37	Bedf		$3\frac{1}{3}$	$1\frac{1}{3}$	$\frac{2}{3}$	12	$\frac{2}{3}$	$\frac{2}{3}$	.	$\frac{2}{3}$	....	.	.....	....	..	1561
38	Some		$2\frac{2}{3}$	.	1	$\frac{2}{3}$	1	.	13	6	....	.	.....	....	..	1619
39	India															
40	Jeffer															
41	Warr															
42	Vena		$3\frac{2}{3}$	.	.	.	25	.	.	$\frac{2}{3}$	....	.	.....	....	..	1573
43	Arms															
44	West															
45	Fayet		$9\frac{1}{3}$	.	$11\frac{1}{3}$	.	.	.	$6\frac{1}{3}$	.	....	.	.....	....	..	1607
46	Greer															
47	Wash															
48	Alleg		1	.	$\frac{1}{3}$	$\frac{1}{3}$	$2\frac{2}{3}$	.	19	2	....	.	.....	....	..	1571
49	Beav		4	$\frac{1}{3}$	$\frac{1}{3}$	.	$9\frac{1}{3}$	$\frac{1}{3}$	8	$2\frac{2}{3}$	....	.	.....	....	..	1590
50	Butle		$\frac{2}{3}$	.	14	.	2	.	.	.	....	.	.....	....	..	1567
51	Merce															
52	Craw		$1\frac{2}{3}$	.	$\frac{2}{3}$	.	.	.	$17\frac{2}{3}$	1	....	.	.....	....	..	1566
53	Erie,															

E

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
AUGUST, 1841.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia,	Philadelphia,	E. W. Hamilton,										
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	65.10	76.97	65.29	85.00	54.00	69.12	⅓	54.00	61.45	..
4 Lehigh,												
5 Northampton,												
6 Monroe,	Stroudsburg,	A. M. Stokes,										
7 Pike,												
8 Wayne,												
9 Susquehanna,	Silver Lake,	E. Rose,	68.36	81.10	70.80	92.00	60.00	73.42	.	57.00	63.10	..
10 Luzerne,												
11 Schuylkill,	Port Carbon	P. C. Lyceum,										
12 Berks,												
13 Chester,												
14 Delaware,	Haverford,	Haverford School,	68.55	76.58	69.13	82.00	52.00	71.42	1	58.00	64.74	..
15 Lancaster,	Lancaster,	Conservatory of Arts,	66.22	83.23	69.13	86.00	58.00	72.86	⅔	57.00	64.08	..
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	70.39	82.54	75.23	87.00	65.00	76.05	1	59.00	65.80	..
19 Northumberland,	Northumberland,	Andrew C. Huston,	67.20	76.26	71.45	83.00	60.00	71.64	.	51.00	59.97	..
20 Columbia,												
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Kinkead,	60.23	78.20	66.64	93.00	49.00	68.36	4	......	......	..
27 Perry,												
28 Cumberland,												
29 Adams,	Gettysburg,	Prof. M. Jacobs,	64.51	79.10	66.69	88.00	57.50	70.10	.	55.00	61.60	..
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	63.63	83.53	69.84	93.00	56.00	72.33	⅔	......	......	..
32 Centre,	Bellefonte,	John Harris,	60.87	80.46	66.41	86.00	47.00	69.25	2	......	......	..
33 Potter,												
34 M'Kean,	Smithport,	M. R. Atkins,	57.55	74.71	63.00	84.00	47.00	65.09	.	44.00	52.87	..
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	59.48	79.43	61.43	91.00	53.00	66.78	2	47.00	54.14	3
37 Bedford,	Bedford,	Samuel Brown,	63.85	82.09	70.27	89.00	57.00	72.17	⅔	......	......	..
38 Somerset,	Somerset,	George Mowry,	63.16	73.40	62.36	81.00	56.00	66.31	6	47.00	55.82	4
39 Indiana,	Indiana,	Richard White,										
40 Jefferson,												
41 Warren,												
42 Venango,	Franklin,	Wm. Connely,	61.52	79.72	68.58	90.00	48.00	69.94	1⅓	......	......	..
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weethee,	66.71	84.23	67.65	90.00	49.00	72.86	.	......	......	..
46 Greene,												
47 Washington,												
48 Allegheny,	Pittsburgh,	J. P. Bakewell,	70.23	75.40	73.55	78.00	65.00	73.06	2	56.00	62.61	..
49 Beaver,	Beaver,	James Allison,	67.07	81.75	67.48	91.00	61.00	72.10	2⅓	51.00	57.52	2
50 Butler,	Butler,	Jacob Mechling,	64.90	78.26	71.39	86.00	54.00	71.52	.	......	......	..
51 Mercer,												
52 Crawford,	Meadville,	Henry Shippen,	64.71	81.74	63.43	94.00	51.00	69.96	⅓	44.00	56.52	..
53 Erie,	Erie,	James C. Reid,										

Barometer. **Weather.**

County.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
3 Bucks,	30.11	30.12	30.10	30.33	29.91	30.11	⅓	14	16⅔	⅓	11	.....	.....	2	10.691
9 Susquehanna,	28.24	28.24	28.23	28.37	28.09	28.24	.	17	14	.	6	.....	.....	..	2.850
14 Delaware,	29.58	29.57	29.56	29.82	29.38	29.57	⅓	12⅓	18	⅔	11	.....	.....	1	7.597
15 Lancaster,	29.61	29.61	29.60	29.85	29.45	29.61	⅔	14⅔	15⅓	⅔	5	.....	.....	2	3.835
18 Dauphin,	30.23	30.22	30.21	30.03	29.63	30.22	1	.	.	.	7	.....	.....	2	1.754
19 Northumberland,	29.60	29.59	29.58	29.84	29.41	29.59	.	8⅓	22⅔	.	9	.....	.....	3	3.864
26 Juniata,	29.57	29.54	29.55	29.79	29.40	29.55	4	16⅓	10⅓	4⅓	5	.....	.....	1	2.740
29 Adams,	29.48	29.47	29.46	29.69	29.34	29.47	.	17⅔	13⅓	.	6	.....	.....	..	3.001
31 Huntingdon,	29.48	29.46	29.46	29.68	29.32	29.46	⅔	23	8	.	6	.....	.....	..	1.618
32 Centre,	29.38	29.37	29.35	29.58	29.17	29.57	2	18⅔	9⅓	3	3	.....	.....	..	2.206
34 M'Kean,	......	......	......	......	......	......	.	21⅓	9⅔	.	8	.....	.....	..	2.410
36 Cambria,	28.02	28.06	28.05	28.26	27.80	28.04	3	13	14	4	8	.....	.....	..	2.226
37 Bedford,	29.35	29.35	29.34	29.58	29.18	29.35	⅔	15⅔	14⅔	⅔	.....	.....	.....	..	....
38 Somerset,	27.97	28.00	27.96	28.17	27.78	27.98	6	10	16	5	3	.....	.....	1	0.798
42 Venango,	29.24	28.83	29.27	29.90	28.83	29.27	.	.	.	.	.....	.....	.....	..	1.490
45 Fayette,	29.12	29.14	29.10	29.29	28.89	29.12	.	25⅓	5⅔	.	.....	.....	.....	..	....
48 Allegheny,	29.37	29.32	29.08	29.96	29.10	29.26	1⅔	11⅔	17⅓	2	4	.....	.....	..	2.380
49 Beaver,	29.52	29.46	29.44	29.70	29.00	29.47	2⅔	15⅓	11⅓	4⅓	5	.....	.....	..	2.860
50 Butler,	28.98	28.95	28.93	29.10	28.70	28.95	.	.	.	.	6	.....	.....	1	5.030
52 Crawford,	28.86	28.84	28.84	29.05	28.60	28.85	⅓	18⅔	11⅓	1	.....	.....	.....	..	1.288

Winds.

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
3 Bucks,	.	⅔	7⅔	⅓	1⅓	⅓	5⅔	½	2	.	6½	⅓	⅓	⅓	3	⅓	.	2
9 Susquehanna,	1⅓	.	.	.	.	.	.	.	2⅓	⅔	8½	.	13	.	5⅓	.	.	.
14 Delaware,	4⅔	2	2⅓	⅓	2	⅓	1⅔	.	.	1	6	1⅔	1⅔	⅓	2	⅓	2⅓	2½
15 Lancaster,	2	2⅓	2	⅓	2⅔	2⅔	1⅓	2⅓	5⅔	1⅓	2	1⅔	1½	.	1	2	.	⅓
18 Dauphin,	2	.	.	.	.	.	2⅔	.	3⅔	.	12⅔	.	10	.	.	.	.	1
19 Northumberland,	3⅓	.	5	.	1⅓	.	⅔	⅔	6⅔	.	⅔	.	6	⅓	2⅔	.	3⅔	.
26 Juniata,	.	.	1⅓	.	⅓	.	5⅔	.	.	.	1½	.	.	.	1	.	19	4⅓
29 Adams,	5⅓	⅔	1⅔	⅔	⅓	.	⅓	2	7⅓	1	1⅔	.	⅔	.	⅔	⅓	8⅓	.
31 Huntingdon,	.	.	.	.	9⅔	.	.	.	.	.	.	.	20⅔	1	.	.	.	.
32 Centre,	⅔	.	4⅓	⅓	⅓	⅓	1⅔	.	3	.	3	1⅓	4⅓	.	3	.	2	5⅔
34 M'Kean,	⅓	.	2⅓	.	3	⅓	6⅔	.	3⅓	.	3⅔	2	6⅓	1	1⅓	.	⅔	.
36 Cambria,	1	.	.	.	.	.	2	.	6	.	3⅔	.	6	.	1⅔	.	8⅓	2⅓
37 Bedford,	⅔	.	.	1⅔	1⅔	4⅓	2⅓	.	7	.	3⅓	1⅓	⅔	12	⅔	⅔	.	⅔
38 Somerset,	1	.	⅓	.	⅓	.	⅓	1	3⅔	.	2⅔	.	1	⅔	1	.	13	6
42 Venango,	.	.	.	.	.	.	1⅔	.	.	.	3⅔	.	.	.	25	.	.	⅔
45 Fayette,	.	.	.	.	⅔	.	3	.	⅓	.	9⅓	.	11⅓	.	.	.	6⅓	.
48 Allegheny,	.	.	.	.	⅔	⅓	4⅔	.	⅓	.	1	.	⅓	⅓	2⅔	.	19	2
49 Beaver,	⅔	.	1⅓	.	.	.	3⅔	.	⅓	.	4	⅓	⅓	.	9⅓	⅓	8	2⅓
50 Butler,	.	.	⅔	.	13	.	⅔	.	.	.	⅔	.	14	.	2	.	.	.
52 Crawford,	1	.	3⅓	.	4	⅓	1	.	⅓	.	1⅔	.	⅔	.	.	.	17⅔	1

Hygrometer.

County.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
3 Bucks,	....	.	.....	....	..	1559
9 Susquehanna,	....	.	.....	....	..	1572
14 Delaware,	54.84	.	.....	73.23	..	1564
15 Lancaster,	62.96	1	.....	68.63	1	1578
18 Dauphin,	....	.	.....	....	..	1558
19 Northumberland,	....	.	.....	70.00	..	1562
26 Juniata,	....	.	.....	....	..	1563
29 Adams,	60.84	1	.....	67.22	1	1574
31 Huntingdon,	....	.	.....	....	..	1579
32 Centre,	....	.	.....	....	..	1565
34 M'Kean,	....	.	.....	....	..	1575
36 Cambria,	....	.	.....	....	..	1570
37 Bedford,	....	.	.....	....	..	1561
38 Somerset,	....	.	.....	....	..	1619
42 Venango,	....	.	.....	....	..	1573
45 Fayette,	....	.	.....	....	..	1557
48 Allegheny,	....	.	.....	....	..	1571
49 Beaver,	....	.	.....	....	..	1580
50 Butler,	....	.	.....	....	..	1567
52 Crawford,	....	.	.....	....	..	1566

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

MARCH, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. By L. Klein, *Civil Engineer.*

[CONTINUED FROM PAGE 79.]

IV.—*Emperor Ferdinand's Northern Railroad.*

The fourth railroad undertaken in Austria is the most extensive in Europe, as it will, when completed with all its branches, have a length of nearly 400 miles; I shall therefore be excused for giving a somewhat more detailed account of it. The main line commences at Vienna, the capital and residence of the Austrian Empire, and terminates at Bochnia in Galicia; from this line branches go to Stockerau, Brunn, Olmutz, Troppau, Dwory and Wielitchka; a branch is also to lead to Presbury in Hungary.

Though projected as early as 1830, it was not until the 4th of March. 1836, that the imperial privilege for this gigantic undertaking was granted to Baron Rothschild, in Vienna, authorizing the formation of a company with a capital of seven millions of dollars. The latter was immediately subscribed, and on the 7th of April, 1837, the works were commenced. In November of the same year, the first trips were made to Wagram, a distance of seven miles, and on the 7th of July, 1839, the line from Vienna to Brunn (the capital of Moravia) was put into operation. With the forty-nine miles opened in the present year, there are now 140 miles in operation, and forty miles more will be comple-

ted in the course of two months. Other fifty-three miles are in progress of construction, and as many miles located, which will be commenced as soon as the necessary funds are procured.

Amongst the principal objects of the northern railroad is the transportation of oxen from the interior of Galicia to the Residence; it has been estimated, that not less than 90,000 are coming annually in this direction. By connecting several important cities with Vienna, this railroad will also command a great travel and a considerable traffic in produce and merchandize; it will in every case contribute largely to develope the resources of those provinces through which it passes, and will become still more important by its connexion with the Warsaw and Vienna, the Bochnia and Lemberg, and the Upper Silesian railroads, of which the first and the third are already in progress.

The following sections of the Emperor Ferdinand's northern railroad are either completed, or in progress of construction:

1. From Vienna to Lundenburg, main line, (opened)	48 miles
2. From Lundenburg to Brunn, branch, (opened)	43
3. From Lundenburg to Hradish, main line, (opened)	35
4. From near Vienna to Stockerau, branch, (opened)	14
5. From Hradish to Prerau, main line, (nearly completed)	26
6. From Prerau to Olmutz, branch, do.	14
Total length completed or nearly so,	180 miles
7. From Prerau to Ostrau, main line, (in progress)	53
8. From Ostrau to Oswiecin, where the Warsaw and Vienna railroad terminates, main line, (located, but not commenced)	49

Notwithstanding the great extent of this railroad, it meets no where with extraordinary difficulties; in passing the different summits, which divide the waters of important rivers, it requires neither tunnels nor inclined planes. The curves have no radius shorter than 1500 feet, and the steepest grade is 17.6 feet per mile, or 1 in 300. This grade has been adopted as a maximum for the whole line, it being regarded here, as in England, a very steep grade.

With the exception of only nineteen miles from Vienna, to where the branch road to Presburg is to leave the main line, the road has only a single track of the ordinary width of 4 feet $8\frac{1}{2}$ inches. The width of the road bed is $12\frac{1}{2}$ feet, and the slopes are $= 1\frac{1}{2}$ to 1. On the line from Vienna to Brunn of ninety-one miles, now two years in operation, the following works have been executed. Excavations and embankments, 6,012,500 cubic yards; 3708 feet of wooden bridges, the most remarkable of which are those over the Danube at Vienna of 1960 feet in length, with spans of 60 feet; 488 feet of wooden

bridges with stone piers; 24 stone bridges and viaducts with 228 arches of different spans; 116 culverts; 198 road crossings, of which 31 are under, 6 over, and the remainder level with, the railway.

The superstructure consists of the iron T rail of 40 lbs. per yard, resting in chairs fastened upon cross ties of oak, larch, or fir, 7¾ feet in length and 12 inches in diameter, half round, and placed 3½ feet apart upon a bed of gravel, 12 inches thick. The chairs at the joints weigh 15 lbs., the others 12 lbs., and the rails are fastened into them by two iron keys driven in from both sides of the chair outside the track. The rails were partly imported from England, partly manufactured in Austria, and the cost per ton (2240 lbs.) was in both cases from 130 to 135 dollars! owing to the high duty on imported iron, and to the inexperience in the manufacture of rails at home. The price of the chairs was 44 dollars per ton, delivered to the road.

The system adopted here in letting the works is different from that generally followed in America, and deserves to be noticed. The line for a section of the railroad being definitely fixed and located, the profiles, showing the excavations and embankments, and the plans of all the works of art, as: bridges, viaducts, road-crossings, culverts, &c., are executed with the necessary detail, and then the estimates, founded upon the prices of materials and labour in the district through which the line passes, and which are ascertained with the utmost precision, are prepared accordingly. Contractors, of whom there are seldom more than two or three parties, then inspect the plans and estimates, and in their written proposals declare *for how much per cent. below the estimated amount* they offer to execute the works. Generally, the latter are let at from eight to twelve per cent. below the Engineers' estimates, and the contractors are nevertheless realizing a good profit. They let the works again in smaller sections to sub-contractors, who employ many female labourers, who work for low wages. The superstructure is not let to contractors, the object of the company being to insure a more solid and durable work.

Besides the principal depots at the termini of the main line and branch roads, and the smaller ones at the intermediate stopping places, there are along the line small houses for the men who watch and repair the road, at intervals of from 1 to 1¼ mile; 80 such houses are between Vienna and Brunn.

The company own at present thirty locomotive engines, of which one was built in Vienna, twenty-four were imported from England, and five from America. Of the latter, the "Baltimore," manufactured by Messrs. Baldwin, Vail & Hufty, in Philadelphia, has been upon the road but a short time, and promises to surpass all others in her performances, as she does by her workmanship and the beautiful ar-

rangement of her parts. The other means of transportation consist in about 180 passenger cars of three different classes, and 200 freight cars. All the cars are four wheeled, and have wheels with wrought iron tires.

According to the last report of the Directors, the following sums had been expended up to the 31st of October, 1840:

For the principal station at Vienna,	197,862	Dollars.
" the section No. 1, from Vienna to Lundenburg,	1,450,832	
" the section No. 2, " Lundenburg to Brunn,	1,262,877	
" the other sections from Lundenburg towards Olmutz,	1,548,977	
" a second track from Vienna to Gaenserndorf, and for other preparatory works towards the construction of the branch road to Presburg,	346,671	
" the branch road to Stockerau,	77,547	
Inventory account—outfit,	456,252	
Interest account,	84,785	
Surveys for the Railroad to Prague,	3,178	
Total,	5,428,981	Dollars.

Up to the present period, the total amount expended by the company of the Northern Railroad, will exceed six millions of dollars.

Amongst the above sums is the interest paid to the Stockholders at the rate of $4.00 per annum on their instalments. It is a general custom on the continent, that Stockholders receive interest on the sums paid in by them, from the day of the first instalment until the road is put into operation. It is an expedient to induce those capitalists to subscribe, who would be unwilling to invest their money, if they had to wait several years, before getting any interest or profit. It needs not be mentioned, that the proceeding is entirely illusory, as the interest must be paid from the Stockholders' own money.

If we deduct this interest, we find the cost of the railway from Vienna to Brunn with the depot at Vienna, 2,713,586 dollars, and as the length is ninety-one miles, the cost per mile of railroad with a single track, exclusive of outfit was 29,800 dollars; with outfit 33,000 dollars.

From the first of November, 1838, to the 31st of October, 1839, in which period the railroad has been entirely opened only during four months, the total number of passengers conveyed was 263,886, the income 125,080 dollars.

In the year ending 31st of October, 1840, there have been transported over the road between Vienna and Brunn:

228,368 passengers, who paid	201,561 Dollars.
32,160 tons of goods	90,063
Income from other sources,	2,548
Total gross income,	294,172 Dollars;

or, 3,233 dollars per mile, equal to 10 per cent. on the capital of construction.

The expenses of working the railroad have been during the same period, 225,547 dollars, or 2,478½ dollars per mile, leaving only 68,625 dollars as net profit, which is 2¼ per cent. on the capital of construction. The number of miles traveled by all the engines was—188,100; the expenses per mile of travel amounted therefore to 1 dollar 25 cents. The principal cause of the comparatively large expenditure is to be found in the great cost of the fuel, for which coke and coal brought from great distances have hitherto been employed; the expenses for fuel alone amounted in 1840 to not less than 98,533 dollars, or to 52.4 cents per mile of travel.

Up to the first of April, 1841, the passenger fare has been per mile in the first class cars 3.16 cents, in the second class 2.01 cents, and in the third class 1.58 cents. The average receipt per passenger per mile in 1840, was 1.77 cents; the average income or charge per ton per mile 5.1 cents. Since April 1841, the passenger fare has been increased to 4.25 cents in the first, 2.65 cents in the second, and 1.77 cents in the third class cars.

In the course of this summer, several trials have been made with heavy transports of oxen from Hradish to Vienna, a distance of 83 miles. From 100 to 180 oxen were carried in a train, each car containing six to eight. The cars are open on top, and only provided with barriers on the four sides; the oxen stand sideways, and are tied on the car with ropes. As the trip is made in seven or eight hours, they receive no food on the road. A commission, specially appointed for this purpose, inspected the cattle when they arrived at Vienna, and declared, that the conveyance upon the railroad is in no way injurious. The butchers also were perfectly satisfied with the result, and are contented to receive their supply in this new manner.

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the new Track now being laid upon the Baltimore and Ohio Railroad, from Harper's Ferry in Virginia, to Cumberland in Maryland, a distance of 96 *miles.*

Communicated by BENJAMIN H. LATROBE, Civil Engineer.

The rail is of rolled iron, imported from England; it is of the bridge,

trough, or inverted U section,* $3\frac{1}{8}$ inches in height, $4\frac{3}{8}$ inches in width at the base, and $2\frac{1}{8}$ inches from out to out of the sides of the upright stems; the bars are in lengths of 20 feet, with their ends cut square, and weigh 340 pounds each, or 51 lbs. per lineal yard.

The rolled iron rail, is supported throughout its length, by a *continuous bearing* of sawed timber, $4\frac{1}{2}$ by 8 inches in section, and in lengths of 20 feet, like the *rail-bars* and *sub-sills.*

The *continuous bearing,* reposes flatwise upon *cross-ties* and *bearing blocks,* the *cross-ties* being $4\frac{1}{2}$ by 6 inches in section, laid flatwise upon the *sub-sills,* and notched on the top $1\frac{1}{2}$ inch deep and 8 inches wide, to receive the *continuous bearing;* this notch being cut $\frac{5}{8}$ths of an inch deeper on the side next the centre of the track, so that the *continuous bearings* when laid on both sides, mutually decline towards each other at the rate of $\frac{5}{8}$ths of an inch in 8 inches, or 1 in 13, thus bringing the top of the iron rail also, into a plane of this inclination, which is the same as that of the cones of the wheels now used upon the Baltimore and Ohio Railroad.

The *bearing blocks* are 3 by 6 inches in section, and 1 foot in length, they are laid crosswise to the track upon their flat sides, and support the *continuous bearing* at points intermediate to the ties, without any notching.

The *cross-ties,* are laid 5 feet apart between their centres, as are the *bearing blocks,* and hence, the *continuous bearing* is supported at points $2\frac{1}{2}$ feet asunder, if we measure from centre to centre of the supports, or has unsupported spaces, of but 2 feet lineal in the clear between their sides.

The *cross-ties* and *bearing blocks,* rest upon *sub-sills,* 3 by 10 inches in section, and also in lengths of 20 feet; at every point of support, the *continuous bearings,* the *cross-ties* or *bearing blocks,* and the *sub-sills,* are pinned together by *tree-nails* $1\frac{1}{4}$ inch in diameter, and going quite through the three timbers; but where the joinings of the *continuous bearing* occur above a *tie,* two *tree-nails* of an inch in diameter (one in each of the meeting ends of the *continuous bearing*) are used.

The joinings of the *rail-bars* upon the opposite sides of the track, break joint with each other midway of their lengths; they also break joint at the same time with the *continuous bearings* upon which they rest, and these in like manner break joint with the *sub-sills;* every

* This pattern of rail, which in section very much resembles the letter U inverted, and hence, in technical phraseology, ought perhaps to be called the U rail; was invented by S. V. Merrick, Esq., of Philadelphia, in 1831, and by him denominated the *Trough rail,* from its resemblance when inverted, to a trough. (See the number of this Journal for August, 1835.) It has been used upon the Wilmington and Susquehanna Railroad, in this country, and the Great Western Railway in England, and continues to give very satisfactory results.—Ed.

joint of two adjacent timbers of the *continuous bearings,* is made to fall upon a *cross-tie,* and all the joinings in the track are merely square butt joints, no scarfs being used; by this system of distributing the weak and strong points, the strength of the track is equalized.

A cast iron *joint chair,* weighing $7\frac{3}{4}$ lbs. is placed under the ends of every two adjacent *rail-bars,* and a *centre chair,* also of cast iron, weighing 4 lbs. under the middle of each rail.

The *joint chairs,* together with the *rail-bars,* are fastened down on the *continuous bearing* by two vertical *screw-bolts,* (one on each side of the chair) going through oblong mortise holes made in the timber, and also, through similar apertures in cast iron *bearing-plates,* fastened up against the bottom of the *continuous bearing,* in the interval between two supports, but close to one: the *screw-bolt* is formed with an oblong square head, fitting the mortise hole in one direction only, so that by making a half turn with it after its head has descended below the *bearing plate* just mentioned, it laps over the sides of the oblong hole in that plate, and falling into a recess cast for the purpose, when drawn up by the nut, the *bearing plate* is thus made to grasp the *continuous bearing* firmly; whilst the nut being screwed down upon a wrought iron washer and zinc plate, (designed to protect the iron by galvanic action) which lap upon the projecting base, or feet of the contiguous bars of the U rail, they are thus secured to the joint chair, and the latter to the *continuous bearing.*

The *centre chair,* and the middles of the *rail-bars,* are held down on the *continuous bearing* by four *brad headed spikes,* (each $4\frac{1}{2}$ inches long and $\frac{7}{16}$ square in the shank;) and the iron rail between the *joint* and *centre chairs* is held by twelve similar spikes driven in pairs, (one on each side) at intervals of $2\frac{1}{2}$ feet.

The *chairs* are let their own thickness ($\frac{5}{8}$th of an inch) into the *continuous bearing,* so that their tops are flush with the upper surface of the latter, and the bottom of the rail bears fairly upon both.

The *chairs* have each a projection going up vertically into the hollow of the rail, and two horizontal semi-circular projections on their ends to fit into half round mortises in the wood, to prevent lateral motion.

The *centre chairs,* moreover, have two square projections on the upper surface, which fit notches of the same dimensions ($\frac{3}{8}$ths of an inch square) in the feet of the rail, to confine the bars from longitudinal movement.*

The whole of the track is laid upon, and partly imbedded into, a

* The *seat* of the rail in the chairs, is elevated about $\frac{1}{8}$th of an inch above the rest, and the castings being made as soft as possible, this admits of a portion of the seat being tooled away, whenever necessary, to enable a compensation to be made for small irregularities in the heights of contiguous rails.

ballasting of broken stone, composing a mass of open material—entirely pervious to water—10 feet wide at bottom, 8 feet at top, and 1 foot in depth: the lower part consisting of stone broken to pass every way through a 2 inch ring, and the upper part of such as will in like manner pass a 4 inch ring: the base of the *ballasting* is about 4½ inches below the bottom of the *sub-sill*, and its top, level with the upper surfaces of the *cross-ties*, or 3 inches below the top of the *continuous bearing*. The distance between the iron rails, or the *gauge of the railway*, is 4 feet 8½ inches.

References to the Plate.

A General plan of the superstructure.
B Side view do.
C Transverse section do.
D Side view at the joint of the rail, showing the rail and its fastenings to the continuous bearing.
E Cross section through the continuous bearing at the joint of a rail.
F Plan of the joint chair.
G End view of do.
H Plan of the centre chair.
I End view of do.
J Plan of the bearing plate.
K Plan of the screw bolt.
L Cross section through the rib of the bearing plate.
M Plan of the nut and washer.

Scale of A, B, and C, ¼th of an inch to the foot, the remainder, being the *details*, are drawn quarter-size.

Baltimore, Md., Feb. 1, 1842.

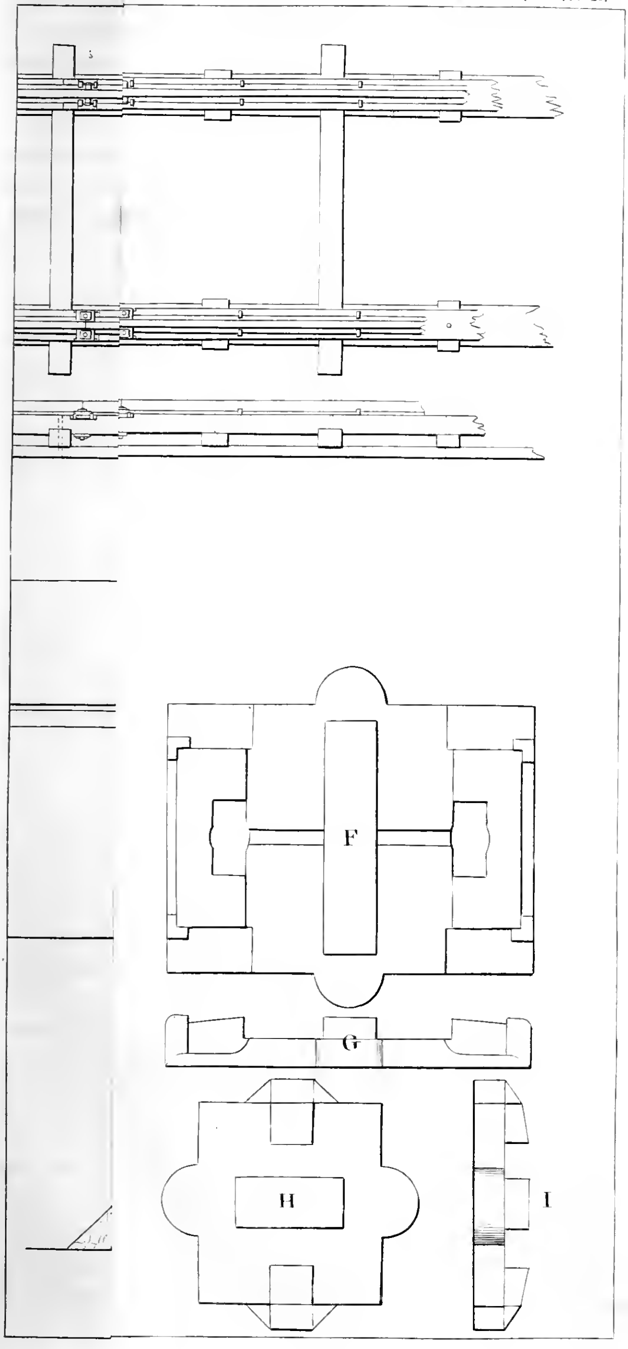
Remarks upon the above. By Ellwood Morris, C. E., *one of the Collaborators for the Department of Civil Engineering.*

We invite attention to the foregoing plan of Railway superstructure, as embodying in a great measure, the experience acquired by the railway practice of the country.*

In 1838, Messrs. Knight and Latrobe, the distinguished Engineers of the Baltimore and Ohio Railroad, were specially commissioned to visit the most important railways in the United States, with the view

* From an inspection of the railways of general trade, which have been the longest in use, the writer is strongly disposed to conclude, that it will eventually be found advisable in such railroads as carry a very heavy traffic, and the earthworks of which have acquired the requisite stability, to lay the superstructures in *a bed of concrete*, as has been suggested in the London Mechanic's Magazine; the expense of which, in such cases, would probably be compensated by the additional smoothness of surface, and freedom from derangement, which such a foundation might fairly be expected to impart to railways.

Jour. Fr... Vol. III. Plate 1.



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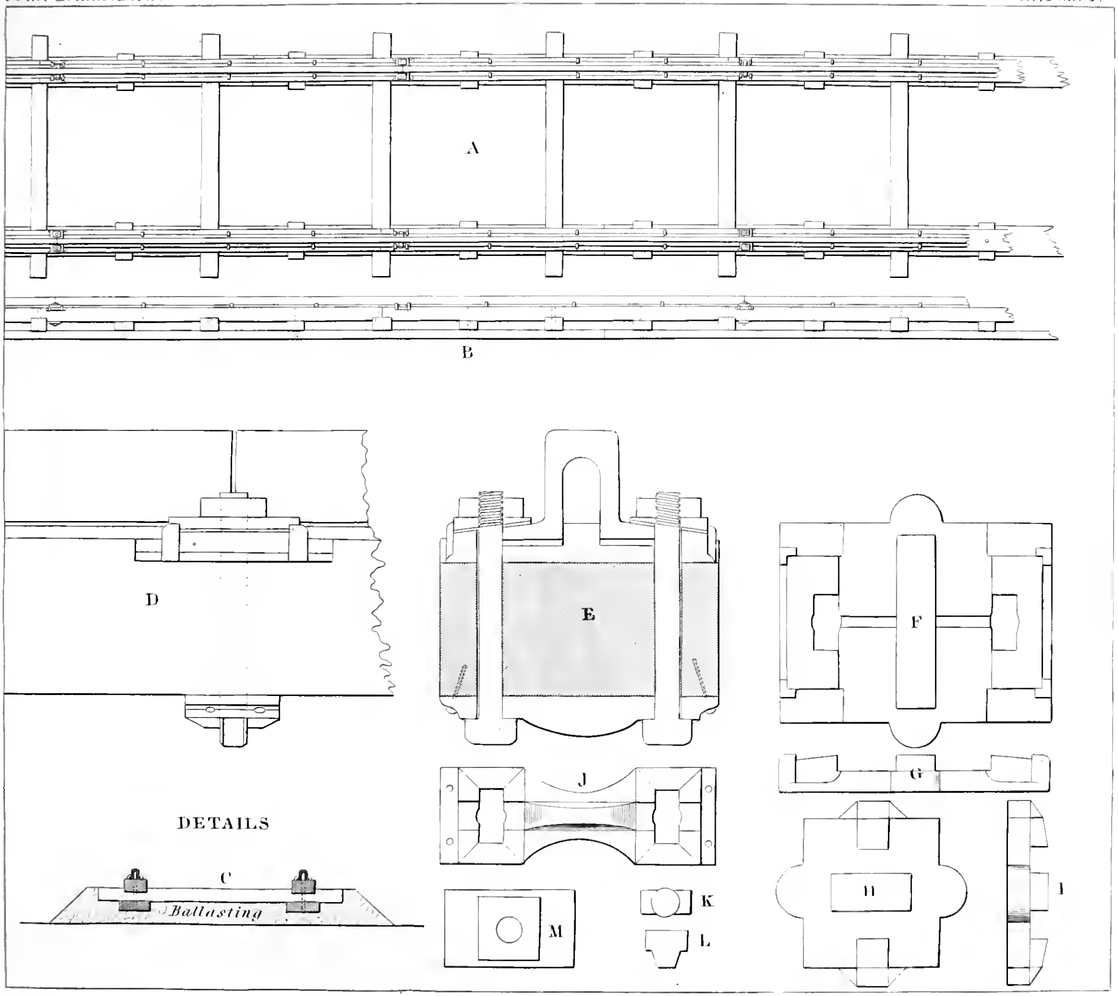
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of availing themselves of the experience of the whole country, in framing a plan for a new track, then about to be laid between Baltimore and Federick, to replace the original superstructure, of which the wood work had decayed and required renewal, and *the stone* continuous bearings had ceased to give satisfaction.

The results of the observations of these Engineers, were reported to the Directors of the Baltimore and Ohio Railroad Company, in an able and elaborate memoir, describing minutely the rails, fastenings, &c., of the most conspicuous railroads then actually in operation, or nearly completed; they discussed in detail the merits of the various plans of railway, which came under their observation; and ultimately recommended a superstructure having a sub-sill and cross-ties, surmounted by a rolled iron H rail of 50 lbs. to the yard, in lengths of 18 feet, with angular joints, and for which the cross-ties formed isolated bearings of $2\frac{1}{2}$ feet asunder, from centre to centre, except at the ends of the bars, where the bearings were made but $1\frac{1}{2}$ feet, conformably to Barlow's experiments; this superstructure was designed to be embedded in a broken stone ballasting, of one foot deep; and many miles upon this plan were laid in 1839, and have since been in constant use.

A number of railways have been laid down without any *sub-sills*, and if they could be properly dispensed with, it would certainly be desirable; but it is found in practice that detached sleepers, resting either on the grade directly, or on broken stone, settle so unequally, as soon to render the road dangerously rough; and hence, a strong feeling in favor of sub-sills to equalize the settlement of superstructures, has grown up amongst Engineers, and it is certain at least, that they are used upon the best railways in the country.

Though there are, of course, some variations in the details of the fastenings, &c., the superstructure above described differs from that adopted in 1838—at the suggestion of the same gentlemen—mainly in two particulars:

1. In having *a continuous bearing of timber* beneath the rolled iron rail, upon which it rests throughout its length.

2. In the adoption of the U, bridge, or trough section, for the iron rail, in lieu of either the T or H patterns.

These two essential variations from the plan of railway superstructure, recommended by Messrs. Knight and Latrobe, in 1838, are fully justified, if not absolutely demanded, by the practical experience upon these points, now dawning upon the country; which at an earlier period in the history of railways, could not perhaps have been foreseen, and certainly was not anticipated.

With regard to the first point, a close observation of such of the American railroads as have been the longest in use—possessed of the

largest trade—and traveled by the heavy locomotive steam engines, which are now so common, will fully satisfy any professional man, that the alternate succession of *"rigid points and flexible spaces,"* which inevitably results from the employment of *isolated bearings,* tends to a more rapid destruction, both of the locomotive machinery and of the road itself, than is likely to ensue, where the iron edge rails are sustained upon *continuous bearings of timber* of heavy proportions; which plan has also the recommendation of having already been practically tested upon the Baltimore and Port Deposite, and Washington branch railroads in this country, and the Great Western, and London and Croydon railways in England—with satisfactory results in each of these cases, so far as the writer is informed—besides being employed upon some other important railways in America, which are now in the course of construction.

Concerning the second point, or the sectional form of the rail—we will observe that the top table of the bars, upon which the wheels run, in the T and H forms—being supported in the centre alone by a single upright stem, in thickness, about one fourth only of the width of the head—soon crushes off on one side or the other of the centre, and renders it necessary to reverse the position of the bars.

On the Baltimore and Ohio Railroad, as the writer is informed, *already* has occasion been found to reverse the position of a number of the bars (of the track laid with the 50lbs. H rails in 1839) *whose inner flanges have partially peeled off!* and upon the Columbia Railroad, which has been *but seven years in use,* rolled iron rails of the T and H forms may be seen in every stage of destruction;* and though a portion of the disintegration which may there be witnessed, is undoubtedly owing to the intrinsic structure of rolled iron, and hence can only be postponed, and not annihilated, by any change of form or

* Time was, when Engineers generally, were under the impression that rolled iron edge rails of 50 lbs. to the yard, would last from forty to sixty years, but experience is fast dissipating all such ideas, by demonstrating that the duration of rails of malleable iron is not determined by mere superficial wear, but, *by the time which it requires for a given trade rolling upon them, to disrupt the bars into their elementary laminæ;* and the present indications of experience are, that upon railways possessing an amount of trade, equal to that which annually traverses the railroad between Philadelphia and Columbia, rolled iron edge rails of the T and H forms and of ordinary dimensions, will not endure more than ten years.

That the public authorities of our state are becoming aware of the probability of this, may be inferred from the following extract taken from the late report on the condition of the Columbia railroad, made to the Canal Commissioners of Pennsylvania, by W. B. Hufnagle, Esq., the Engineer in charge of that work during the past year.

"One fact, (says Mr. Hufnagle) however, cannot be concealed, that the iron rail which forms the heaviest item in the construction of a railway, exhibits strong symptoms of coming destruction, and even now, a portion should be replaced with new iron of an improved pattern;—the laminæ of which it is composed appear to have become detached, and exfoliate

pattern; still it must be admitted, that if the top table of the rail had been so supported as to prevent it from being forcibly disrupted from its vertical stem, and thus render it subject alone to the natural exfoliations, which occur when malleable iron is exposed to a series of great rolling weights, the durability of that railway would have been essentially increased.

The sort of support to the head of the rail, which practice now shows to be necessary, is given by the double stems of the U section, and not by the single one of the T figure; consequently, it seems to the writer that, experience on existing works, demands in future ones the adoption of the former pattern, in outline at least; for it is a question which time alone can determine, whether we shall not finally come to a solid bar rail as the best; for the present, however, it will probably be the proper course to use the U rail as now rolled hollow, in which form, as it can be made as light as the T and H patterns, its superior durability will gradually cause rails of the latter figure to pass from use, and give place to those of the former pattern, unless a superior section should meanwhile be introduced.

To support these views, it would be easy to cite further examples of the decay of rails of the T and H forms; but it seems scarcely to be necessary, and upon the whole, we are disposed to conclude that the experience of the country, up to this time, indicates the propriety of adopting in future railway superstructures, *a continuous bearing of timber laid with a U rail, upon a suitable substructure*, in preference to any of the other plans now in use, most, if not all of which, seem on trial to possess fewer practical advantages.

In fine, the new superstructure of the Baltimore and Ohio Railroad, appears to combine in its plan, a sufficient provision to satisfy the most important requisites, in favor of which, the railway practice of the country has pronounced—viz:

1. That to guard against disturbance by frost or rainy weather, the superstructure ought to be embedded in a *ballasting*, entirely pervious to water, and of a sufficient depth.

2. That to prevent the track from spreading laterally, numerous *cross-ties* should be employed.

3. That to prevent unequal settlement of the *cross-ties* (which also

under the pressure of the cars, thereby requiring the rail to be reversed, or rendered useless,—this reversion has so frequently taken place that prudence would dictate the importation of at least 50 tons to supply the defective parts."

Here is a striking verification of the prediction made many years ago concerning rails of malleable iron, by W. Chapman, of Newcastle, a distinguished English Engineer, (see Wood on railroads) whose opinions were then strenuously combated by other Engineers, who must now, or soon, admit, that Mr. Chapman's anticipations *were truly prophetic.*

form detached supports for the rails or continuous bearings) ***sub-sills*** of wood are indispensable.

4. That to render the road more smooth, more equal in strength throughout, capable of carrying greater weights than roads of isolated bearing, and exempt from "rigid points and flexible spaces," *continuous bearings of timber* ought to be employed to carry the iron rail.

5. That the iron rail itself ought to be of the U pattern, (either hollow or solid) as superior in durability to any other known form of section, now in actual use, whilst it is very stable in position, and cheap in its fastenings when properly laid.

6. That the iron rail-bars ought to be firmly fixed at their middle parts, to cause expansion and contraction to take place, both ways from their centres.

These are the principal points to be attended to, though there are others of importance in arranging the details, which will so readily occur to persons conversant with these matters, as not to require any particular reference.

The propriety of augmenting, by any economical means, the durability of the timber of railways, is evidently of the last importance; and it appears to the writer that the process of impregnating wood with the pyrolignite of iron, by means of the aspiration of the sap of newly felled trees,—as prescribed by M. Boucherie,—furnishes a cheap practical mode of rendering timber almost indestructible; and to this process, we would solicit the attention of Engineers, and others connected with railways, in the most pointed manner.

The admirable preservative process of M. Boucherie, has recently been ordered by the Minister of the Marine, (after numerous experiments) to be applied upon a great scale to the preparation of timber for the use of the navy of France; and the "modus operandi" translated from the French periodicals, by Professor J. F. Frazer, may be found detailed at length in this Journal for 1841, to which we refer for more minute information upon this point, as well as for the record of a curious series of experiments on the protection from putrefaction, which is afforded to vegetable substances of the most destructible character, by mixture with solutions of corrosive sublimate, pyrolignite of iron, &c.

To render the description of the new track of the Baltimore and Ohio Railroad still more complete, we have below taken the quantities of the several component materials, (as furnished to us by Mr. Latrobe) and applied to them the scale of prices assumed by that gentleman, in his pamphlet upon the Z rail (as an average for the United States) in comparing the expense of sixteen different tracks of rail-

way, used or projected; (see p. 179 of this Journal for March, 1841) so that in this manner the relative cost of the plan under consideration, may be ascertained, and compared with the rest.

Estimate of the cost of one mile of single track railway, upon the plan now being constructed upon the Baltimore and Ohio Railroad, between Harper's Ferry and Cumberland, (96 miles) using the actual quantities of all materials, and the scale of prices, by which the cost of the same extent of the other railway superstructures, quoted on the next page, has been in each case calculated.

Ballasting.

950 Perches of broken stone to pass through a two inch ring.
950 Perches of ditto, to pass through a four inch ring,

1,900 Perches of *ballasting*, at 87½ cents. $1,662 50

Lumber.

				Ft. B. M.	
10,560	ft. lineal of	3 × 10	*sub-sills* in lengths of 20 ft.	26,400	
10,560	do	4½ × 8	*continuous bearings* do.	31,680	
7,392	do	4½ × 6	*cross-ties* in lengths of 7 ft.	16,632	
2,112	do	3 × 6	*bearing blocks* " of 1 ft.	3,168	
				77,880	
77,880	Ft. B. M. of *Lumber*, at $25 per M.				1,947 00

Tree-nails.

3,696 *Tree-nails,* for *ties and blocks,* 12 in. long, 1¼ in. diam.
1,056 *Tree-nails,* for *joints of bearings* 12 in. long, 1 in. diam.

4,752 *Tree-nails* at 1 cent each, average 47 52

Rails of Rolled Iron.

80 tons, in lengths of 20 feet, at $70 per ton, 5,600 00

Fastenings of the Rails.

528	*Cast iron joint chairs,*	each weighing	7¾ lbs.	4,092 lbs.	
528	do *centre chairs,*	do	4 lbs.	2,112 "	
528	do *bearing plates,*	do	2¾ lbs.	1,452 "	
				7,656	
	7,656 lbs. *cast iron fastenings* at 4½c. per lb.				344 52
1,056	*Wrought iron screw bolts and nuts* for joint chairs, weighing each 1½ lbs.			1,584 lbs.	
1,056	*Wrought iron washers* for ditto, $\frac{9}{16}$ lbs. each,			594	
				2,178	

Carried over, $9,601 54

	Brought forward,	$9,601 54
	2,178 lbs. *wrought iron bolt fastenings*, at 12c. per lb.	261 36
8,448	*Brad headed wrought iron spikes*, for middle chairs and intermediate fastenings, at 4¼ oz. each, 2,247 lbs.	
	2,247 lbs. *wrought iron spike fastenings*, at 9c. per lb.	202 23
1,056	*Zinc washers*, 10 to the lb.—106 lbs. at 10c. per lb.	10 60
	Workmanship.	
320	rods of workmanship in laying the track, at 2,75 cents, per rod lineal,	880 00
	Total per mile of single track,	$10,955 73

Such is the cost of a road upon the plan described, and with the prices assumed; but as some of these are higher than are now actually being paid by the Baltimore and Ohio Railroad Company to their contractors, the cost to that company will not probably exceed $10,000 per mile of single track, notwithstanding all the materials used by them are of the very best quality.

Comparative cost per mile of single track of several railway superstructures, compiled from B. H. Latrobe's pamphlet on his projected Z rail.

1.	New Jersey Railroad,	T rail	38 lbs.	per yard	$10,700
2.	Boston and Worcester,	T rail	38½	do	10,637
3.	Baltimore and Susquehanna,	H rail	58½	do	11,556
4.	Stonington and Providence,	H rail	58	do	11,149
5.	Long Island,	H rail	56½	do	10,587
6.	Boston and Providence,	H rail	55	do	10,352
7.	Baltimore and Ohio, (track of 1838,)	H rail	52	do	10,354
8.	Philadelphia and Reading,	H rail	45⅛	do	9,451
9.	Camden and Amboy,	H rail	45	do	9,114
10.	Newcastle and Frenchtown,	H rail	43½	do	8,736
11.	Washington Branch,	H rail	40	do	9,519
12.	Baltimore & Port Deposite,	square rail	40	do	9,428
13.	Wilmington and Susquehanna,	U rail	40	do	8,752
14.	Projected track Baltimore and Ohio Railroad,	U rail	45	do	9,927
15.	do	Z rail	45	do	9,482
16.	do	Z rail	35	do	8,169
17.	Track (of 1841) above described, Baltimore and Ohio Railroad,	U rail	51	do	10,956
					17)168,869
	Average cost per mile of seventeen tracks,				$9,933

As it has now been officially announced that the rolled iron edge rails of the Columbia railroad "exhibit strong symptoms of coming destruction," it is a matter of great interest to ascertain as nearly as possible the amount of trade, which has produced such a result.

With this view, the writer has carefully examined the reports of the Canal Commissioners of this State, and though we must regret that the information there made public, is not sufficiently detailed to enable us to decide the question with accuracy, still we can form some approximation to the truth.

By data obtained in the reports referred to, for the years from 1835 to 1841, inclusive, we find that:

In 1835,	1,188	Engines hauled over the road, (77 miles)	10,588	cars.
" 1836,	2,493	do	24,043	"
" 1837,	2,977	do	38,064	"
* " 1838,	3,608	do	45,364	"
" 1839,	4,239	do	52,664	"
† " 1840,	4,980	do	57,520	"
" 1841,	5,720	do	62,375	"
	25,205		290,618	

Now allowing the mean weight of the above Engines, including their tenders to have been sixteen tons each, and that each of the cars, including its load weighed three tons, (both of which are mere suppositions, the official documents not giving the tonnage) we find that the gross amount of the above traffic has been, *approximately*,

		Tons.
25,205	Locomotive Steam Engines, at 16 tons,	403,280
290,618	Cars, loaded and empty, averaging three tons,	871,854
	Probable gross tonnage, including 1841, say	1,275,134

The gross trade therefore, which has reduced the rails of this road to their present dilapidated condition, may be stated at *thirteen hundred thousand tons,* unequally distributed upon two tracks, but in point of fact chiefly carried by one.

From present appearances, it would not be an unreasonable inference, that ere the aggregate tonnage passed upon this double track railway, by the aid of Locomotive steam power, shall have reached the amount of *two millions of tons gross,* the destruction of the edge rails of rolled iron of the Wigan and other similar patterns, weighing

* Estimated at a mean between 1837 and 1839, the official report for 1838 furnishing no data.

† Estimated at a mean between 1839 and 1841, in consequence of the report for 1840 not supplying the information.

from thirty-three to forty-two pounds per yard, *will be complete;* or in other words, by the time that number of tons gross (with its usual distribution on the two tracks) shall have rolled upon their surfaces, the top tables of those rails will be entirely crushed off from their vertical stems, and the rails themselves rendered useless.

And it must not be forgotten in this connexion, that many miles of stone and wooden superstructure upon this same road, have already been worn out or abandoned, and hence, that our estimate of durability leans in favor of the existing rails, rather than otherwise.

Finally, as the greater part of the tonnage of the Columbia railway has probably been carried upon one track only, the experience developed in its use goes far to justify a belief, that rails of the T and H patterns, similar to those employed here, are incapable of carrying more trade upon a single track than about *fifteen hundred thousand tons, gross weight.*

James River and Kanawha Improvement.

We learn from the seventh annual report to the Stockholders, made by Judge Cabell, the President, in December, 1841, and for which we are indebted to the politeness of E. H. Gill, Esq., Civil Engineer; that this magnificent line of transport—by which Virginia is opening through the heart of her territory a cheap route for the carriage of goods, between steamboat navigation upon the Ohio and tide-water at Richmond—is actively progressing.

The Stockholders, assembled in general meeting, have resolved to memorialize the Legislature of Virginia for such an alteration of their charter, as will allow them to dispense with the railway portage of 138 miles, hitherto proposed between the head waters of the Kanawha and the James; and to substitute in lieu of it a Turnpike and Canal improvement, consisting of a continuation eastward of their steamboat navigation, an additional distance of 116 miles, by means of the New and Greenbrier rivers—tributaries of the Great Kanawha—to Greenbrier bridge, and thence by a M'Adamized road of twenty-seven miles in length to Covington, the proposed head of the canal upon the James.

This arrangement, however, is not designed to be final, for they propose eventually to complete across the Alleghany, *a continuous canal navigation for boats of sixty tons burden!* and meanwhile only to use the turnpike portage of twenty-seven miles.

By the plan of 1838, the James and Kanawha improvement would consist of

	Miles.
Canal from Richmond to Covington,	239
Railroad from Covington to Loup Creek Shoals on the Great Kanawha,	138
Steamboat navigation from Loup Creek to mouth of Great Kanawha,	88
Total length,	465

By the plan of 1841, the James and Kanawha improvement would consist of

	Miles.
Canal from Richmond to Covington,	239
Turnpike from Covington to Greenbrier bridge,	27
Steamboat navigation from Greenbrier bridge to the mouth of the Great Kanawha,	204
Total length,	470

From the report of Mr. Gill, the surveying Engineer, sanctioned by the approbation of Benjamin Wright, Esq., their distinguished Engineer in chief, it appears that the estimated expense of executing the plan of 1841, does not exceed that of 1838, as formerly projected and estimated.

Inclusive of the charges of *freight, toll,* and *transhipment,* Mr. Gill estimates the expense of transporting *one ton* of agricultural productions from the confluence of the Ohio and Kanawha, to tidewater on the seaboard, by three different routes, as follows:

1. *To Richmond,* via. steamboat navigation on the Kanawha, turnpike portage, and James River Canal, $15 18

2. *To Philadelphia,* via. steamboat navigation on the Ohio to Pittsburg, and thence by Canal and two railway portages through Pennsylvania, $22 82

3. *To New York,* via. Ohio Canal, Lake Erie, Erie Canal, and Hudson river, $24 78

If these calculations should be found correct in practice, the extraordinary fact will be developed, *that the cheapest line of transportation for the carriage of heavy freight, between the valley of the Ohio and the sea, lays through the interior of Virginia.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Explosion of the Boiler of the Steamboat Citizen. By Thos. Ewbank, Esq.

TO THE COMMITTEE ON PUBLICATIONS.

On Monday, the 7th inst., as the steamboat *Citizen* was preparing to tow a packet ship from one of the docks of this city, her boiler exploded; according to some persons present it was blown into "a thou-

sand pieces." Of them a solitary fragment is all that is left, the rest fell into the water. The boiler was placed fore and aft upon the deck, and with the exception of the engine and smoke pipe, every thing connected with it, including the deck, was swept overboard. Three or four persons were wounded, two seriously, but none killed.

Supposing you might wish to add this explosion to the list kept by the Institute, I have sent the annexed sketches of the boiler, taken from plans in possession of the maker. It will be seen that its construction was similar to that of the Ohio, Gibbon, and New England. It was made of one quarter inch American iron, was about three years old, and had recently been thoroughly repaired. The *immediate* cause of the disaster is said to have been a deficiency of water. The engine was not in motion at the time. The usual strength of steam employed was fifteen inches; but on some previous occasions it had been raised to forty inches. The Engineer was a fresh hand, having been on board but a few days. From the effects produced, there can be little doubt that the steam was pretty *high;* and from the construction of the boiler and lack of water, the vertical flue within the steam chimney was most likely overheated and collapsed.

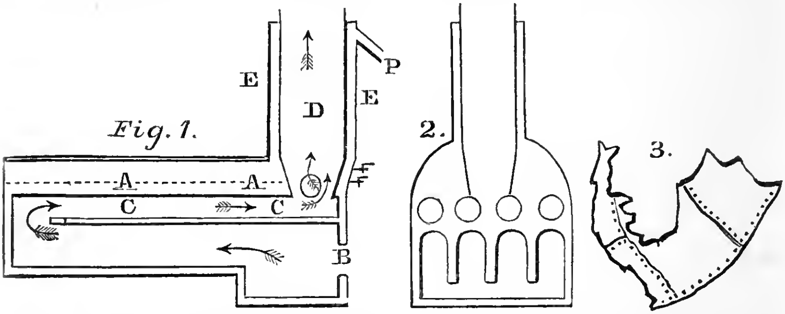


Fig. 1, is a longitudinal section. B, one of the openings for the fire doors. C, C, a horizontal flue terminating in the vertical one D, which was surrounded by the steam chimney E, E. The arrows show the direction of the smoke and flame. A, A, the water line. P, the steam pipe. There were four return flues all terminating in the vertical one.

Fig. 2, a section across the front end of the boiler.

Fig. 3, the only part of the boiler left. It does not exceed five or six feet in any direction. Some patches are on it and part of two new plates, recently put in. No part seems much worn. Two or three interior braces remain attached. The boiler was about sixteen feet long and eight feet wide. The horizontal flues were cylindrical and about sixteen inches diameter.

This is another proof of the correctness of the opinion of the Committee on Explosions respecting such boilers, and I am afraid many more will yet have to be recorded.

Very respectfully.

THOS. EWBANK.

New York, February 10th, 1842.

Explosions in Smelting Furnaces.

Translated for the Journal of the Franklin Institute, by Prof. Jno. F. Frazer.

The Annales des Mines, for January 1841, contains an interesting note upon certain explosions which have taken place in smelting furnaces, in the department of Ardennes, while employing the hot blast with baked wood.

Five explosions, of which three were very serious, took place in the course of three years; the last four occurring in rapid succession. Of these five, the last two are described in detail.

At the furnace de la Commune, on the 18th December, 1840, during the evening, half an hour after the casting, a current of gas rushed violently from the lower part of the furnace above the crucible. A loud detonation was heard. Two men who happened to be in the direction of the current were thrown down and burned. Three other workmen were greatly injured. The buildings connected with the establishment were set fire to. Upon examining the circumstances of the furnace before the explosion, it was found that the apparatus had been working irregularly for eight days previously, that the charges descended by successive falls, and out of forty or fifty that were thrown in in the twenty-four hours, four or five presented this irregular action. Each sudden descent was accompanied by a jet of gas which rose higher than usual above the throat.

During this period of eight days, the embrasure of the tuyere was completely closed, as has been for some time customary in many establishments.

A few hours before the casting which preceded the accident, the iron being completely gray, about 250lbs. of ore were thrown in by the tuyere, at different intervals, in order to whiten it.

An hour before the casting, there came a slag, very fluid, black, and charged with oxide of iron, which generally indicates a fall of the ore. At this time, the tympe was closed preparatory to casting, and for this purpose the crust of slag was suffered to harden. Nothing peculiar was observed at the tuyere; the blast was strong and steady; the casting was made. The three openings for casting, are disposed vertically. The middle one was opened and the iron run out—the same was done with the lower, and the crucible emptied within a few pounds. After a few minutes, when they wished to close completely the middle orifice, by pushing back the slag which had accumulated in contact with the plate, and introducing a clay plug, they again obtained a copious issue of iron.

A quarter of an hour afterwards a new charge was thrown into the furnace, this descended rapidly: a second was thrown upon it. The flame issued from the throat with great velocity and rose very high. It was then that the flames were perceived in the crevices of the furnace throughout its whole height. Gas entered by the tuyere, and escaped, burning, from the mastic-joints of the air-pipes. The crucible being entirely closed, the flames did not shew themselves at the tympe.

A few moments before the accident, the founder thought that he perceived that the nozzle of the air-pipe was obstructed. He thought that the slag had accumulated too high upon the iron, and went to the tympe to break the hard crust. As soon as he had withdrawn his poker, he perceived a powerful current issuing from the opening which he had made, and hurried to the flood-gate in order to diminish the velocity of the wheel, and consequently the quantity of air—the explosion took place before he reached it.

The gas, issuing from the narrow orifice which the founder had made, projected before it both iron and slag. The crucible was emptied, and the ground covered an inch deep with slag. The gas knocked down the workmen, who fell in the midst of this red hot mass, and at the same time covered them with fused iron and cinder. At the throat nothing remarkable was seen; from 100 to 120lbs. of ore and charcoal were thrown out of the furnace. By this explosion, the air-tubes were broken, and the air ceased to enter the furnace. At three o'clock in the morning, there were about six charges short, the most of which had been thrown out of the tympe. The furnace was then filled with charcoal and closed. Two days afterwards it was again put into action, after every thing had been repaired. When I visited it, it was working very well; the charges descended regularly and without sudden falls. They were working with open tuyeres. When I inquired into the behaviour of the furnace during the two months preceding the accident, I found that before the period of eight days, which has been described, a cooling had taken place in the apparatus. The slag had got into the tuyere and diminished its section; the quantity of air introduced into the furnace was less than usual. Not more than thirty charges were introduced within the twenty-four hours, in place of fifty. They had worked for nearly two months, without detecting this obstruction, finally it was discovered, and things restored to their proper condition.

The accident at the furnace de la Fade happened three weeks after that which we have described, but no one was injured by it. A powerful explosion took place, not by the tympe, but by the throat, upon the eighth of January, after the evening casting. M. Lagard, the proprietor, to whom I had communicated the result of my observations at the other furnace, desiring to examine whether any obstruction had taken place in the furnace, suffered it to cool.

The hot air apparatus had required repairs, and the furnace had been working for several days with the cold blast. The accident happened three days after the resumption of the hot blast—thirty-six hours before the accident the charges descended more rapidly than usual; and upon the day of the explosion, (which took place at five o'clock, in the afternoon,) from eleven until one o'clock, the filler could no longer keep pace with the working of the furnace. He was assisted by another, and four charges were introduced in succession. With this exception, up to the moment of casting, the furnace worked steadily. During this period also, an alteration was made in the charge. The charge of baked wood was increased to five-sixths in place of four-sixths, which had been before used, and the proportion of charcoal

was proportionally diminished. At about half-past four o'clock, in the evening, the gases at the throat were peaceable and their flow feeble. A minute before the explosion, a projection took place at the tuyere (the embrasure had always remained open;) the gases which enveloped the hot air apparatus detonated, and a current of gas issued from the tympe. The projections then began from the throat, and lasted for nearly two minutes. The furnace was almost entirely emptied. At this time, also, the flames issued from the crevices and interstices of the masonry.

Upon an examination of the interior of the furnace, there was found no trace of any permanent obstruction, by semi-fused masses cemented to the inner walls of the furnace.

Both these furnaces were similar in their dimensions; both worked easily fusible ores in fine grains, yielding about forty per cent. of cast iron; both used as the combustible, a mixture of charcoal and baked wood (or rather dried wood, for it rarely loses more than thirty per cent of its weight.)

M. Sauvage, the Engineer, to whom we owe this account, attributes these explosions to the evolution of gases from the wood, within the cavities which form in the furnaces during the irregular action described. The intense heat finally gives to these gases sufficient tension to burst suddenly the opposing barriers, and thus the explosions take place.

An account of a similar accident which occurred upon the 24th of December, 1840, at the furnace of Vanvey, Department Côte d'Or, is given by M. de Nerville. It would seem that in this case, the effect was due to the very irregular action of the hot-air blast, which was heated only by the combustible gases conducted from the furnace throat. The heat given to the blast must consequently vary materially with the quantity of gas issuing from the furnace.* The explosion took place from the tympe.

"The examination of the facts which preceded and followed this unfortunate accident, does not permit us to doubt, that the projection of the matters contained in the crucible was solely due to the fall of a large mass of the ore not yet deprived of water, upon the liquid iron and slag. A vault had formed in the furnace, and that there existed a large empty space below it, is evident from the fact that after the accident, the ore and charcoal contained in the furnace was so thrown down, as to present at the throat a depression of nearly six feet. It may easily be conceived that the fall of such a mass into the crucible would force out iron and slag, and cause the instantaneous formation of steam."

* The apparatus, arranged at the tunnel-head, to collect the gases, presented, moreover, the disadvantage of preventing the proper arrangement of the ore in the furnace, which instead of being evenly distributed, was piled up around the walls.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Strength of Iron Wire at a low Temperature.

The following experiments were made with iron wire $\frac{1}{18}$ inch in diameter, subjected to direct strain:

	At 50 Fahr.		At Zero.
1st experiment broke with	215 lbs.	-	214 lbs.
2d " "	210 "	-	200 "
3d " "	212 "	-	206 "
4th " "	200 "	-	204 "
5th " "	210 "	-	218 "
6th " "	208 "	-	226 "
7th " "	218 "	-	200 "
8th " "	210 "	-	204 "
9th " "	224 "	-	228 "
10th " "	216 "	-	206 "
11th " "	216 "	-	220 "
12th " "	226 "	-	202 "
Mean,	214	Mean,	211

JOHN M. BATCHELDER.

Saco, Maine, Feb. 24th, 1842.

Physical Science.

Notice of a Spiral Magnet, by which Secondary Currents may be demonstrated in the body of the Magnet. By CHAS. G. PAGE, M. D., *Washington, D. C.*

More than three years since, while investigating the action of *closed* secondary currents, I was led to the conclusion that these currents must be developed in the body of the magnet itself, as well as in the coils of metal surrounding the magnet. (See Silliman's Journal, vol. 35, No. 2, page 255.) Prof. Henry, engaged about the same time in a similar train of investigations, had arrived at the same conclusion.

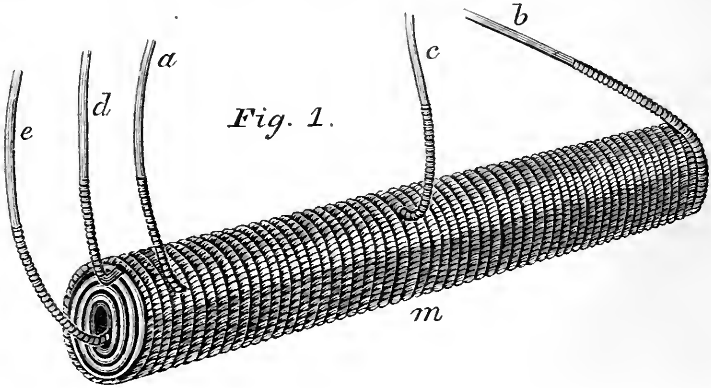
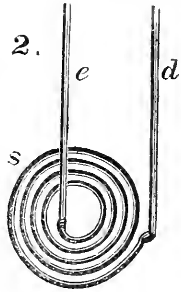


Fig. 1.

We had both, however, been anticipated by the conjectures of Prof. Ettinghausen, of Vienna. Since that time the existence of these currents has been regarded only as a matter of reasonable inference, and I know of no attempts to elicit and demonstrate them by the common tests. In the experiments above alluded to, I failed to detect these currents, from the want of a delicate Galvanoscope; but the magnet about to be described, affords currents of sufficient magnitude to be appreciated by shocks and bright sparks.

The magnet *m*, fig. 1, consists of a long sheet of very thin iron, rolled up in the form of a cylinder, and covered with three layers of insulated copper wire, the ends of which are soldered to the single wires *a*, *b*, for the purpose of communication with a galvanic battery. A sheet of paper is rolled up with the sheet of iron to insulate the several turns of the spiral. The wire *c* is soldered to the middle of the outer edge of the sheet; the wire *d* is also connected with the outer edge. The wire *e* is connected with its inner edge. Fig. 2, is an end view of the magnet exhibiting its spiral turns, with a fold of paper between. When the wires *a* and *b* are connected with the poles of a galvanic battery, the inclosed sheet of iron becomes a strong magnet. When the galvanic connexion is broken, a brilliant spark occurs, showing a power in this respect, superior to that of a solid bar of iron. If the ends of *d* and *e* be joined, a momentary current is obtained both at the completion and the rupture of the galvanic circuit. If *e* and *c* be joined, the current is much stronger than from *d* and *e*. It appears from this, that the wires *d* and *e* conduct the currents from only a single transverse section of the magnet, while the currents from *e* and *c* are constrained to deviate from their natural course, viz. at right angles to the axis of the magnet, and take an oblique direction from one angle of the sheet to the middle of the opposite edge. The direction of these currents I have ascertained is in conformity with the law of secondary currents, as follows:—The initial secondary is in opposition to the primitive current, the terminal secondary in the same direction with the primitive.

2.

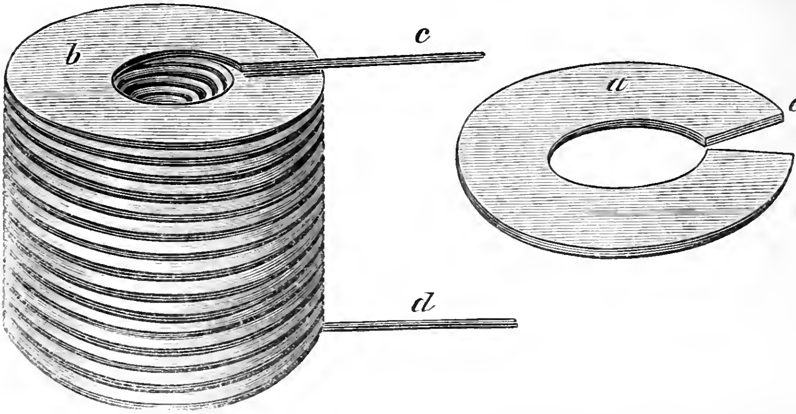


Description of a new plate, or quantity, Helix, for Electro Magnetic Apparatus. *By* Chas. G. Page, M. D., *Washington, D. C.*

The design of the new helix, is firstly to obtain a maximum of magnetic influence, by surrounding an iron bar with the greatest possible number of circumvolutions of conducting metal within a given space, and to bring those conducting circuits as near as possible to a direction at right angles to the axis of the magnetic bar.

Secondly, the plate helix affords a means of modifying magneto-electric currents, so as to obtain the maximum of their magnetizing influence. I have therefore called this a quantity helix, to distinguish

it from helices of wire, in which the magnetizing property of the currents diminish in a certain ratio to the extent of wire employed.



When a magnetic bar is to be covered with copper wire wrapped with silk or cotton, it is evident that the *double* thickness of the insulating material, increases the obliquity of the wire to the axis of the magnet, besides occupying space which should be given to the conducting metal. The round form of the wire also, necessarily involves much waste room. The conditions requisite to the full economy of magnetizing power seem to be well answered by the plate helix. *a*, fig. 2, represents one of the plates of which the helix is composed. It is an annular plate of copper, about three inches in diameter, the opening in the centre being from three quarters to an inch in diameter, to admit the magnetic bar. The plate is cut open at *e*, and one of these cut edges is soldered to the edge of a similar plate, and thus the series continued to any extent desired. Upon the upper surface of each plate a piece of thin paper of the same size and form is fastened with varnish, for the purpose of insulation. *b* represents the helix with the copper wires *c* and *d* attached to its extremities. I have not yet fully ascertained the value of this helix, but from the experiments already made with it, am confident it will answer my expectations. It magnetizes powerfully, gives brilliant sparks, and will be a valuable instrument for exhibiting the magnetic effects of mechanical electricity, as it can be stretched open to an extent which will not allow the electricity to pass from one plate to another, except in the direction of continuity.

Franklin Institute.

The Annual Meeting of the Institute was held at their Hall, January 20th, 1842.

THOMAS FLETCHER, Vice President, in the Chair;
GEORGE W. SMITH, Recording Secretary, P. T.
The minutes of the last meeting were read and approved.

Donations were received from the Hon. Charles Brown, Member of Congress; the Young Mens' Mercantile Library Association, of Cincinnati, Ohio; Prof. Alex. Dallas Bache, Jno. D. Koecker, John White, Charles B. Trego, Prof. Walter R. Johnson, Charles Ellett, Jr., A. D. Chaloner, M. D., Henry R. Campbell, the Select and Common Councils of the City of Philadelphia, Andrew Fountain, A. Pardee, Zebeelon Parker, of Newark, Ohio; Calvin Olds, of Marleboro', Vt., and from the Estate of John Ronaldson, Esq., deceased.

The Corresponding Secretary laid on the tables the periodicals received in exchange for the Journal of the Institute.

The annual report of the Board of Managers was read and accepted, and referred for publication.

The Treasurer presented his report of the funds for the last quarter, and also a statement for the year ending December 31st, 1841—which were read and accepted.

Mr. Henry R. Campbell, from the Committee of Tellers of the annual election for Officers and Managers of the Institute, for the ensuing year, (appointed at the preparatory meeting this day,) presented their report of the result of the election, when the Vice President declared the following gentlemen duly elected:

Samuel V. Merrick, President.
Isaiah Lukens, } Vice Presidents.
Thomas Fletcher, }
Isaac B. Garrigues, Recording Secretary.
Alex. Dallas Bache, Corresponding Secretary.
Frederick Fraley, Treasurer.

Managers.

Abraham Miller,	Henry D. Rogers,
John Struthers,	Ambrose W. Thompson,
Matthias W. Baldwin,	George Taber,
John Agnew,	Thomas U. Walter,
John Wiegand,	John H. Towne,
Samuel Hufty,	James Hutchinson,
John C. Cresson,	Edwin Greble,
Andrew M. Eastwick,	David S. Brown,
Isaac P. Morris,	Paul W. Newhall,
Charles B. Trego,	Thomas S. Stewart,
John S. Warner,	William B. Fling,
William Hart Carr,	Joseph Yeager,

(Extract from the minutes.)

Thomas Fletcher, *Vice President.*

George W. Smith, *Rec. Secr'y., P. T.*

Eighteenth Annual Report of the Board of Managers of the Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts.

The Board of Managers beg leave to present their eighteenth annual report:

On retiring, it becomes the duty of the Board to render an account of their proceedings during the past year. The details of the operations of the past year must determine whether on the retrospect we can perceive a steady advance in the primary objects of the Institute. The Spirit of the Age is onward, and although there has been, and is much to embarrass and depress it, in which the Institute has largely shared, yet we think we see around us a sure guarantee, that our future course must be onward, in imparting knowledge in the various *able* modes employed by the Institute, and thereby usefulness to society and the world.

The great increase of Lectures by the various Associations, who have followed the example of the Institute in this respect, would naturally have led the Board to expect a decrease in attendance upon those of the Institute. This has, however, not been experienced; and they are fully satisfied, that could the accommodations for the classes be enlarged, the attendance would be much increased.

The Professors of the Institute have fully sustained the high opinions that have been expressed of their Lectures, and it is but justice to acknowledge the obligations, under which the Board and the Institute are placed to them.

The courses for the season are in progress as follows:—General Chemistry, on Monday evenings, by Prof. John F. Frazer. Mechanics and Natural Philosophy, on Wednesday evenings, by Prof. John C. Cresson. Chemistry as applied to the Arts, on Friday evenings, by Prof. James C. Booth. Prof. Thomas U. Walter has completed a course on Architecture, occupying Thursday evenings.

In addition to the above, Prof. Frazer has volunteered a course on Geology, which now occupies the evenings of Thursday. Doct. W. Beck Diver is delivering a course of Lectures on China, on Saturday evenings; by this arrangement, there are five courses of Lectures in each week now in progress. The Board have also to report that S. S. Halderman, Esq., has kindly volunteered to deliver a few Lectures on Zoology.

Under its new organization, the Committee on Publications have succeeded in adding very considerably to the interest of the Journal, and much praise is due to the gentlemen who have so liberally consented to act as Collaborators, and who have so freely contributed their time and labour to enhance the value of this publication. It would be a source of great gratification to the Board, could they note as much in the extent of its patronage, (particularly from the members of the Institute) as they can in its merits.

From the Committee on Science and the Arts, we learn that the number of subjects or inventions connected with Mechanics and the useful Arts, examined by that Committee through their Sub-Committees, during the past year, is seventy-three; of these, thirty remained from the year 1840, and forty-three were new; but twelve subjects remain undisposed of from the year just past.

Four medals and premiums have been awarded to ingenious inventors from the Scott's Legacy Fund, under authority from the City Councils. By a recent ordinance, the award of these medals and pre-

miums is continued with the Managers of the Franklin Institute, for a further period of seven years.

The Cabinet of Minerals belonging to the Institute continues to receive attention, being properly classified and arranged, and is constantly increasing by the addition of new specimens received as donations, or in exchange.

At their stated meeting in November, the Board enlarged the committee, having charge of this department, and authorized a division of the committee into two branches; one to have cognizance of such matters as relate more particularly to *Geology*, while the other, as heretofore, will attend to *Mineralogy*.

The Geological branch of this committee have commenced the arrangement of a Cabinet of Specimens, illustrative of the Science of Geology, in a room which has been appropriated and fitted up for this purpose, and which, with some further extension of shelves and cases, will be sufficient for the reception of an extensive suite of specimens.

It is believed, that from the resources already within the reach of the committee, together with such aid as they expect to receive hereafter, such a collection will be formed as will be creditable to the Institute, and highly instructive to those of our members who are desirous of studying this interesting branch of useful knowledge. As a means of further increasing this Cabinet, it is hoped that such of the members as possess, or may obtain, specimens of rocks, fossils, and minerals, either useful or curious, will be willing to contribute their aid towards rendering the collection still more complete and extensive.

Of the meteorological instruments made under the direction of the Committee on Meteorology, each of the counties of the State has been supplied with a set, except three. This omission is occasioned either by a difficulty in getting the instruments transported, or in procuring suitable persons to volunteer to take charge of them. From twenty-six to twenty-eight counties make regular monthly reports, and these counties being distributed in every part of the State, afford ample means of estimating the modifications of climate and other atmospheric changes in the various portions of our Commonwealth.

In addition to the reports received from our counties, a number are regularly addressed to the committee from gentlemen interested in the subject, residing in various sections of the Union.

A table of means from the reports, furnished by observers, has been regularly published monthly, since January 1839.

Of the original appropriation furnished by the State for Meteorological purposes, the balance on hand, December 31st, 1841, amounts to $429.84.

The monthly conversation meetings, under the care of the committee on monthly meetings, continue to attract the attention of the members of the Institute. It is believed that the usefulness as well as the interest of these meetings, may be considerably extended by an increased exertion on the part of the members of the Institute. As the committee is now organized, every member may add to the means of instruction.

The committee on the Cabinet of Models are steadily increasing the

collection under their charge, and have them so arranged, that they can be examined at any time by the members. The rooms are much frequented by strangers visiting the city.

The collection under the charge of the committee on the Cabinet of Arts and Manufactures, is yet in its infancy; but the committee have succeeded in procuring a very valuable and interesting collection of specimens of the progress of the Arts. As it is intended to embrace all the branches of manufactures, the attention of the members of the Institute is particularly requested to furnish specimens from their establishments, as well as from other sources.

As the Institute for several years past, have been in the practice of holding their exhibitions of American Manufactures, but once in two years, the committee on Premiums and Exhibitions during the past year have not had any special business to claim their attention.

The Library committee have devoted their attention to their appropriate duties, and during the past year, the increase has been by purchase, seventy-six volumes; donations, 126; exchange, 119; in all, 321 volumes.

The Drawing School, under the superintendence of Mr. William Mason, is extending the benefits to be there obtained to forty scholars. The well known ability of the gentleman, to whom this department of instruction is committed, needs no comment from the Board.

In the death of our late lamented President, James Ronaldson, Esq., which occurred on the 29th day of last March, the Institute lost a much valued friend.

During the past year eighty-five new members have been elected; 152 have resigned, and as near as can be ascertained, ten have deceased.

The following gentlemen have become life members:—James Crissey, Thomas Betton, M. D., W. J. Lewis, Wm. Hemble, Thos. Hunt, Wm. F. Geddes, George Snider, J. C. Montgomery, S. C. Henszey, George Taber, Jas. T. Allen, George W. Cross, and John G. Clark.

James H. Bulkley, *Chairman.*

William Hamilton, *Actuary.*

Minutes of the Board of Managers.

At a meeting of the Board of Managers, held January 26th, 1842,

Frederick Fraley, Esq., was elected Chairman of the Board for the ensuing year; and

Messrs. John S. Warner, and Edwin Greble, Curators.

At a subsequent meeting, the following Standing Committees for the ensuing year were appointed:

On the Library.

Thomas S. Stewart, *Chairman.*	Joseph Yeager,
Ambrose W. Thompson,	Alfred L. Elwyn, M. D.
Isaac P. Morris,	Robert Lindsay,
Thomas U. Walter.	

On Geology and Mineralogy.

Charles B. Trego, *Chairman.*
Isaiah Lukens,
Abraham Miller,
Samuel Hufty,
Henry D. Rogers,
James C. Booth,
John F. Frazer,
Richard C. Taylor,
John H. Towne.

On the Cabinet of Models.

Isaac P. Morris, *Chairman.*
John Agnew,
Andrew M. Eastwick,
Thomas S. Stewart,
William B. Fling,
John M'Clure.

On the Cabinet of Arts and Manufactures.

James C. Booth, *Chairman.*
Charles B. Trego,
John Struthers,
John H. Towne,
Edwin Greble,
John F. Frazer,
Joseph Saxton,
James C. Hand,
Lewellyan S. Haskell.

On Publications.

John C. Cresson, *Chairman.*
Alex. Dallas Bache,
Samuel V. Merrick,
Matthias W. Baldwin,
Isaac P. Morris.

On Premiums and Exhibitions.

Samuel V. Merrick, *Chairman.*
John C. Cresson,
Alex. Dallas Bache,
Thomas Fletcher,
John Struthers,
John S. Warner.

On Instruction.

Alex. Dallas Bache, *Chairman.*
Frederick Fraley,
John Wiegand,
Charles B. Trego,
Paul W. Newhall.

On Monthly Meetings.

Roswell Parke, *Chairman.*
John C. Cresson,
Robert Hare, M. D.,
Thomas Fletcher,
William H. Carr,
James Hutchinson,
George Taber,
Joseph Saxton,
Albert W. Metcalf.

On Meteorology.

G. Emerson, M. D., *Chairman.*
John C. Cresson,
Roswell Parke,
Henry D. Rogers,
Owen Evans.

On Finance.

Samuel V. Merrick, *Chairman.*
Frederick Fraley,
Matthias W. Baldwin,
David S. Brown,
John Wiegand.

Managers of the Sinking Fund.

Samuel V. Merrick, *Chairman.* David S. Brown,
Frederick Fraley, Paul W. Newhall.
Matthias W. Baldwin,

Auditors.

Isaac B. Garrigues, *Chairman.* William Hart Carr.
Ambrose W. Thompson,
(Extract from the minutes.)

Frederick Fraley, *Chairman.*

William Hamilton, *Actuary.*

COMMITTEE ON SCIENCE AND THE ARTS.

Baxter's Hot Air Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a plan for a Hot Air Engine, invented by Mr. Morris Baxter, of Marshall county, Illinois, REPORT:—

That Mr. Baxter proposes to obtain a moving power from the expansive force of air, heated in suitable reservoirs, and allowed to act on pistons after the manner of steam. So far as the committee can learn, there is no reason to doubt that the idea of this *hot air* engine is original with Mr. Baxter, and that he supposed himself to be the first discoverer of a new source of power. The first duty of the committee was to disabuse him of this error, by shewing what has been proposed by Dr. Arnott, and other inventors of similar schemes.

This ungracious task being accomplished, the present inventor desires the opinion of the committee as to the merit of his peculiar mode of applying the principle to practice. The only peculiarity suggested in this case, is that of condensing the air into one-quarter, or any smaller fraction, of its natural volume, before subjecting it to heat. By this means it is supposed that less heat will be required to raise its temperature through any given thermometric range, that the bulk of the machine will be materially reduced, and that, possibly, some gain might arise by using a series of expansions, beginning with a tension of six or eight atmospheres, instead of two or less.

There can be no doubt, that if this species of engine should ever be brought into use, some advantage would arise from the greater compactness attained by using the air in a condensed state, and that some small saving of heat would be caused by the diminished bulk of the solid parts of the engine; but the experiments of M. M. De la Vive and Marcet, shew that the capacity for heat of all elastic fluids, increases with their density, and that consequently, a pound of air will require the same heat to raise its temperature through any range, if it occupy but one cubic foot of space, as it would if expanded to 100 feet.

The remaining part of the enquiry is whether the effect produced by the elastic expansion of a gas is proportional to its initial density, or varies according to some function of the density differing from a sim-

ple proportion. This question resolves itself into the mathematical determination of the sum of all the ordinates representing the elastic force at different periods of expansion, which is equivalent to the area of the logarithmic curve. A member of the Institute, well known for his mathematical acquirements, has kindly furnished the committee with a solution of this problem, in which it is demonstrated, that from the constancy of the subtangent of the logarithmic curve, the area of the curve is simply proportional to the value of the ordinate representing the density, and therefore, no gain can arise in this respect from using air condensed previous to heating.

By order of the Committee.

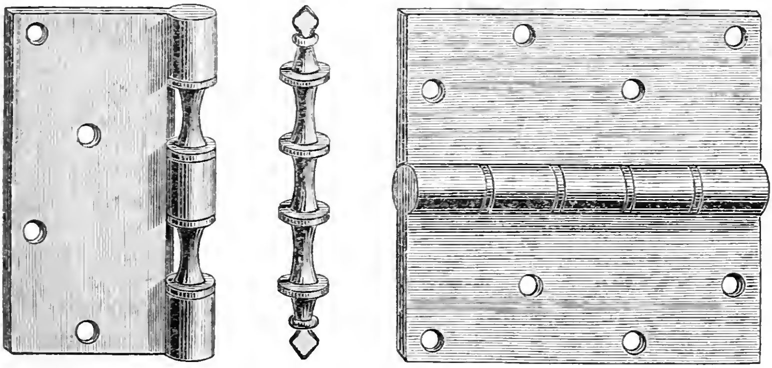
February 10*th*, 1842. William Hamilton, Actuary.

Shepherd's Cast Iron Butt Hinges.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination Cast Iron Butt Hinges, invented by Mr. Thomas Shepherd, and manufactured by Mr. William Hart Carr, of Philadelphia, Pennsylvania, REPORT:—

The hinges submitted to the inspection of the committee comprised all the principal forms used in building. They are composed entirely of cast iron, and in this respect, differ from the kinds fabricated abroad; these latter hinges being generally furnished with pins or spindles of wrought iron. The hinges made by Mr. Carr are cast into com-

b *a* *c*



plete form by three operations: the first of these is to form the spindle *a*, which is effected by casting rods of metal into suitable lengths for use, which rods resemble a string of obtuse cones, joined together by their apices and bases. These are broken into proper lengths for the hinges intended to be cast, and by an adjustment of the mould, and filling up the interstices between the cones with sand, one half of the hinge *b*, is cast over the proper portions of the spindle, leaving the protected parts thereof uncovered by the flow of melted metal. The remaining half is then cast in a mould, adjusted so as to permit the introduction of the portion already fitted to the spindle, and by the application of a

suitable paste, the melted metal poured into the mould to complete the hinge *c* is prevented from adhering to those parts which are required to form the opening and turning parts of the hinge. They are then ground and finished in the usual manner for market.

From some trials of the strength of the hinges made by Mr. Carr, as compared with the best article of English manufacture, particularly in reference to the ability of the spindle to bear a blow or strain, the committee is of opinion, that they are fully equal in those respects to the foreign article.

And from the fact communicated to the committee, that they can be furnished at as low a price as those coming from abroad, they conceive the ingenuity and skill evinced in their fabrication to be worthy of high praise.

The whole process of manufacturing the hinges appears to the committee to be new, and to furnish by its results an article extensively useful in buildings of a very substantial character; and in form and style, very creditable indeed to the gentleman who have embarked in its manufacture.

By order of the Committee,

William Hamilton, Actuary.

February 10*th*, 1842.

Corrosion of Iron in Steam Boilers and Stove Pipes.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Corrosion of Iron in Steam Boilers and Stove Pipes, where Anthracite is employed as fuel, REPORT:—

That they have gathered such information as lay in their power from those who have witnessed the corrosive action, and combined it with their own observations.

It appears that stove-pipes are frequently corroded in the course of a year or two, where they are not taken down or cleansed subsequent to their employment through the winter season. An instance is known in which forty feet of pipe were corroded and rendered a perfect colander in the course of two years. Nor does it appear always as a necessary condition that the place should be damp, although this is the case in a majority of instances, for in the corrosion just noticed, the proprietor stated that the stove was very dry. The corrosion rarely happens in an upright pipe, but usually in one lying horizontally, for where such corrosion had already commenced it was said, in one instance, to have been obviated by giving the pipe a slight inclination. Where it takes place in an upright pipe, it may arise from the flowing down of corroding matter from a horizontal layer of the same.

The same kind of corrosion is observable in steam boilers in which anthracite is employed as fuel, and not in those in which bituminous coal is used. That it does not arise from the intensity of the heat is shown from the fact, that it is greatest in the boiler-flues which lie horizontally at a distance from the fire. A corrosion is sometimes ob-

served near the top of the smoke pipe in steamboats, but this may be attributed to the alternate action of heat, cold, air, and moisture.

It would appear then, that the corrosion is caused either by the vapors arising from the combustion of anthracite, or from matter carried up mechanically by the draft; or from both combined. That it does not proceed from uncondensable gaseous matter is proved by the occurrence of the corrosion only when a stove-pipe is no longer exposed to these vapors during the summer season, or where a boiler is cooled from intermitted fires. It does not arise from matter carried up mechanically, for this could only be ashes, and we know that the ashes of anthracite is of a dry nature; and without moisture, chemical action, or the corrosion, could not occur. It must, therefore, be produced from condensable vapors.

On examining the interior of a stove-pipe lying horizontally, whether corroded or not, we find a loose ashy deposite of a greyish brown color; and where corrosion has taken place, the greater part is condensed into a solid mass, showing that it had absorbed water. Upon fracturing the solid material, small white crystals appear under the microscope, which are generally too imperfect to admit of recognising their form. By subliming the mass, a little empyreumatic oil and water are formed, but the greater part sublimed is an ammoniacal salt. Upon testing a solution of the ashes, it shows a large content of muriate and sulphate of ammonia, the former evidently in much greater quantity than the sulphate. After complete sublimation at a red heat, the ashy matter remaining appears to be nearly pure charcoal or lamp black, with a mere trace of coal ashes. From the qualitative tests made, it would appear that the ammoniacal salts constitute at least three-fourths of the whole mass. A mere trace of iron was detected.

From this content of saline matter, as well as from its nature, we are at no loss to account for the corrosion of iron where the air and moisture add their conjoint action; but it may be doubted whether the ashy matter has the power of absorbing moisture from an atmosphere of ordinary dryness, for in dry situations, it appears that there is usually no corrosion, and in the case noticed at the commencement of the report, it may be doubted whether the stove was dry.

How to obviate the corrosive action is a more difficult point to determine, unless the very simple process be resorted to, of cleaning out stove-pipes every spring, and boiler-flues every few weeks. If the stove-pipes are required to remain standing with the sediment in them, then a previous internal coating of white lead, litharge, or red lead might probably answer the best purpose, since it would result in the production of chloride and sulphate of lead, while the ammonia would be driven off. The thin coating of these salts of lead might then prevent the contact and farther action of the ashy deposite. Experiments made at the U. S. Mint during the winter of 40—41, seem to show that a coating of lime on the interior of a pipe prevents corrosion, and it is said that a few stove manufacturers in this city are acquainted with the fact. The committee, however, in the face of these facts, are rather inclined to believe that the oxide of lead will prove more efficient, since the sulphate of lead is a wholly inert salt, and the chloride

nearly insoluble, while the sulphate of lime is somewhat soluble, and the chloride of calcium very soluble, and therefore likely to produce corrosive action eventually. Still the operation of whitewashing is the simplest mode of obviating corrosion, and may be repeated at intervals.

The content of chlorine to such an extent as is developed by the above chemical examination, is interesting in a geological point of view, since it has not hitherto been found in chemical examinations of anthracite. Prof. H. D. Rogers, in 1836, pointed out the fact, that where heaps of refuse matter were burned near the coal mines, ammoniacal salts, and among them muriate of ammonia are sublimed, and may be found among the ashes. Now we know that saline waters are obtained from the coal measures in the western district of Pennsylvania, and moreover, it is the prevailing opinion among Geologists, that the coal series are marine deposites; we can therefore explain the origin of the muriate of ammonia in the ashy deposite arising from the combustion of anthracite, by attributing the chlorine to the presence of a trace of chloride of sodium (common salt) in the coal or its accompanying slate, or possibly in both. It is unnecessary to allude to the formation of ammonia, since it is a universal product to a greater or less extent of the dry distillation or combustion of every kind of coal.

This ammoniacal deposite is interesting in an economical point of view, since it accumulates in considerable quantity in a single season, and may be collected with facility. In one instance at least, ten pounds were removed from about eight to ten feet of pipe, which was the produce of three or four years, and hence, we may estimate the large amount that might be obtained from many hundred pipes in Philadelphia every season. It may be employed either for the manufacture of sal ammoniac by a very simple process of sublimation with a small quantity of a salt of lime, or it may be directly applied in powder or in solution to garden-soils. The influence of ammoniacal salts in promoting luxuriant vegetation has long been known, but the admirable work of Prof. Liebig on Agricultural Chemistry, has more completely developed their influence and importance. The material before us will unquestionably prove of great value to the gardener and florist, if properly applied to the soil; but it must not be forgotten that it is very rich in ammonia, and should therefore be employed sparingly.

By order of the Committee,

February 10*th*, 1842. William Hamilton, Actuary.

Baldwin & Vail's Locomotive Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a six wheeled, geared, Locomotive Engine, intended for the transportation of heavy freight trains, manufactured by Messrs. Baldwin & Vail, of Philadelphia, Pennsylvania, REPORT:—

That the sub-committee appointed to examine the above mentioned engine, met upon the Columbia railroad on the 25th of January,

1842, and went with the engine out to the Schuylkill bridge, and returned with it to Broad street, drawing a train of burthen cars, the gross load being about 200 tons, which was much below the limit of the engine's power, but included all the cars that were then ready to be brought in.

The peculiarity of this engine consists in its obtaining the adhesion of the four wheels of the truck, in addition to that of the main driving wheels, without preventing the truck from vibrating so as to accommodate itself to the curves and undulations of the road. Experience upon the American roads, as far as known to this committee, proves that engines having six wheels and provided with leading trucks. move much more steadily than those with only four, and, as a partial loss of power and other injurious consequences result from the slipping of the driving wheels of locomotives, (which often occurs to a considerable extent, even when it does not prevent the engine from drawing its load, and is not noticed by the engine-man) it is very desirable to obtain the adhesion of all the wheels, without losing the advantages of a vibrating truck.

The difficulty in doing this arises from the fact, that when the engine stands on a curve, the axles of the truck wheels are not parallel to that of the main driving wheels. Messrs. Baldwin & Vail obviate the difficulty in the following manner. A pair of main driving wheels, forty-four inches in diameter, are placed behind the fire-box, as in their well-known form of engine, but the axle, instead of being cranked, is straight, and the connecting rods from the pistons of the cylinders have outside connexions;* and attached to the same wrists are other connecting rods, extending forward and giving motion to a shaft under the front part of the boiler and between the axles of the truck, which shaft is secured so as to maintain its parallelism with the axle of the main driving-wheels, at right angles to the axis of the boiler. On the middle of this shaft a cog wheel is fixed, having chilled cogs slightly rounded on the face, which, by means of two intervening wheels, give motion to others on the axles of the truck. The four truck-wheels are thirty-three inches in diameter, and the gearing is proportioned so as to make them travel at the rate of the larger wheels.

The steam cylinders are thirteen inches in diameter and sixteen inches stroke. The gross weight of the engine in running order is 29,980 lbs., which is apportioned so that 11,755 lbs. are on the two points of contact with the road behind the fire-box, and 18,225 lbs. on the four points of contact under the truck. When tried upon the Columbia railroad in the presence of the committee, the engine drew its train readily around curves of 757 feet radius, the rounded surfaces of the chilled cog gearing allowing the axles of the truck to suit themselves to the curvature of the track. The engine passed with ease around a curve of ninety degrees, having a radius of 312 feet, the train being detached, and afterwards backed itself around a curve of seventy-five feet radius without difficulty.

The engine has since been in use upon the Reading railroad, and it appears from a certificate of Mr. Nicolls, the Superintendent, that on

* This improvement is applicable to engines with cranked axles.

the 12th of February, it drew from Reading to the Columbia railroad, a distance of fifty-four miles, a train of 117 loaded freight-cars; the cars weighing 215, and the freight 375 tons, making a gross load of 590 tons. The speed when in motion being ten miles per hour.

In the opinion of the committee, this engine combines in a high degree the advantages of a vibrating truck with the use of the adhesion of all the wheels; they think it well worthy of the attention of railroad companies doing a freighting business, and believe that it will add to the deservedly high reputation of the builders.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

February 21st, 1842.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1840, AND JANUARY, 1841.

With Remarks and Exemplifications by the Editor.

51. For improvements in *Valves for the Pneumatic Railway,* applicable to other purposes; Samuel Clegg and Jacob Samuda, Sidmouth street, Gray's Inn lane, Middlesex county, England, December 31.

The subject of this patent is a mode of rendering air-tight the valve which closes up the slot, through which passes the connexion between the carriages of the pneumatic railway and the piston working in the cylinder, and which is applicable to machinery in general, in which such connexion is required. These valves work on a hinge of leather attached to one side of the slot, and the other falls into a trough filled with a composition of bees wax and tallow, or bees wax and oil so compounded as to be solid at the usual temperature of the atmosphere, and fluid a few degrees above it. The valve is opened by the connexion between the piston and the carriage, or other body outside, and falls back after it has passed, and is pressed again in its place by a roller, or other body, passing over it; and this is followed by a heated body of metal, which melts the compound, and hermetically seals the valve.

Claim.—"We do not claim the precise size or form of the various parts, or the using of the precise materials herein described; but we claim exclusively the method of constructing and using valves as herein above described, for rendering available the application of direct tractive force, either on railways or otherwise."

1. For a mode of *Graduating the velocity of moving bodies*; Edwin W. Jackson, Albany, New York, January 5.

This patent is obtained for a mode of regulating the velocity of moving bodies, which are subjected to the influence of an irregular or

accelerating force; such for example, as cars on an inclined plane, falling bodies, carriages drawn by restive horses, &c. &c. The apparatus employed consists of two concentric cylinders, connected together at their ends by flanches, with a space between them which is separated into equal compartments by partitions, provided with apertures, the capacity of which may be regulated by valves or shutters. Quicksilver, shot, sand, or water, is to be put into this space, in sufficient quantity to fill about one third of the compartments. To turn this double cylinder with a velocity greater than that with which the quicksilver, or other substance, runs through the apertures in the partitions, sufficient power must be applied to lift the whole contents; and it will be evident that by increasing or diminishing the capacity of the apertures, the facility with which it may be made to revolve will be regulated.

Claim.—"What I claim as my invention is, the mode of graduating the velocity of moving bodies by means of a changeable weight, such as quicksilver, water, sand, shot, &c., contained in receptacles of any given form arranged around or between two concentric cylinders or wheels, and communicating with each other by apertures in the partitions or divisions thereof, through which the changeable weight passes as described. I also claim the mode of regulating the velocity of the moving body by means of valves or shutters, which enlarge or diminish the size of the apertures through which the changeable weight passes."

We are very apprehensive that this extra amount of load will rarely be carried for the purpose of obtaining its regulating influence, and that there are but few situations in which it could be applied with any advantage.

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2. For an improvement in the *Horse Power for driving machinery;* Edmund Warren, city of New York, January 5.

The improvement claimed under this patent is in the mode of connecting the sweep or lever with the master wheel, or with its shaft, so as to prevent breakage by any sudden jar applied either to the sweep or to the machinery. A disk is attached to, and is made to turn with, the shaft of the master wheel, directly under the sweep; and this is provided with two bow springs on opposite sides of its upper surface; the sweep turns on the shaft, but is keyed down so near to the surface of the disk that it cannot turn without bending the bow-springs, which are so regulated, that when the sweep is pressed against them with the constant force necessary to carry the machinery, they do not yield, but when the horse makes a plunge, or the machinery is suddenly obstructed, they then yield, and the sweep passes around without any injury to the machinery.

The claim is to the "combination of the disk, or main wheel arranged as a disk, with the springs upon it, and the lever as a means of relief, or to prevent breakage of machinery."

3. For improvements in the apparatus for *Steering Boats;* Russell Evartz, Madison, New Haven county, Connecticut, January 5.

The steering chain in this apparatus, is made fast to a segment of a wheel at the rudder head, and passing thence, its ends are wound around, and made fast to two drums on a horizontal shaft, under the tiller house—the distance between the two drums must be equal to the diameter of the wheel at the rudder head; the chain, therefore, always acts upon the wheel in the line of its tangent, and the leverage on the rudder will be unvarying. The shaft of the tiller wheel, which has its bearings in a sliding frame, is provided with wheels of different diameters, either of which may be put in gear with a cog wheel on the shaft of the drums to which the steering chain is attached. Two chains are made fast to the rudder, and pass along under the gunwales to the bow, where they are attached to the windlass, by which arrangement the vessel may be steered in case of a fire, which would prevent the use of the tiller or rudder head.

Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in attaching a segment grooved wheel to the head of the rudder, around which the steering chains are passed, and to which they are made fast in such manner that the purchase shall always be at right angles to the diameter, in combination with the grooved drums on the horizontal shaft, around which the steering chains are wound, one on each side, and the gearing for turning said drums at a quicker or slower speed, by the arrangement of the cog wheels in the sliding frame, as described. Also, the arrangement of the life chains leading from the rudder to the windlass, along the gunwales, as before described."

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4. For improvements in the *Blast Furnace for smelting Iron Ores,* with bituminous or with anthracite coal; Stephen Chubbuck and Jedediah Briggs, Wareham, Plymouth county, Massachusetts, January 9.

The improvement in the blast furnace which is the subject of this patent, consists in keeping the melted iron, after it has run from the furnace into a basin provided for it, at the desired temperature by means of a fire on each side of said basin, and under the same arch which covers it. The fires on the sides of the basin communicate with a flue at the side of the smelting stack, which flue is provided with a damper at top, which, when closed, directs the draught through the stack.

Claim.—"What we claim as our invention, is the mode of keeping the metal in its liquid state to a proper degree of heat, by means of fires surrounding the basin containing said metal, and kindled and kept alive in an arch arranged in the manner described; and in combination with the foregoing arrangement, the flue governed by a damper, so operated as to permit the draught from the fires in the arch to ascend the flue, or when closed, forcing it into the smelting stack, as set forth."

5. For a machine for *Cutting Raw Hides or leather into strips* for making Ropes; Philip B. Holmes and William Pedrick, Charlestown, Middlesex county, Massachusetts, January 9.

The claim expresses the character of this invention so clearly, that we deem it unnecessary to add any explanatory remarks.

Claim.—"Having thus described our improvements, we shall claim as our invention, reducing or cutting hides, or other similar materials, into long bands or strips, by means of a revolving table, in combination with a circular or other proper shaped cutting knife, attached to a movable carriage over the same; said knife being caused to pass from the circumference towards the centre of said table, by the action of a revolving screw or similar apparatus, so as to describe a spiral or curved cut through the hide on said table, as the same revolves; the whole being arranged and operating together substantially in the manner as herein above described and set forth. We also claim the supporting of the periphery of the hide above the revolving table, while the circular knife operates thereon, by means of a platform attached to the knife frame through an elongated slot, in which platform the knife is inserted, and acts on the hide resting on the same, the whole being arranged and operating substantially as described."

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6. For an improvement in *Springs for Railroad Cars,* Locomotives, and other vehicles; William Duff, city of Baltimore, January 9.

The patentee says—"My invention consists in the particular manner in which I have combined and arranged the elastic spring made of steel plates, with any desired number of spiral springs, by which arrangement I obtain a high degree of elasticity, and graduate the action of the spring in accordance with the varying burthen which it is to sustain."

The plate springs are arranged and constructed in the usual way, and the spiral springs are placed either between the upper surface of the plate springs and the under surface of the side of the main truck, locomotive, or car, frame; or between the upper surface of the last mentioned side piece and the lower part of the frame of the body. The spiral springs are coiled around rods which pass through the first mentioned side piece, and rest on the upper surface of the plate springs.

Claim.—"What I claim, is the manner in which I have combined the steel plate springs, as constructed with scrolled ends, or with ends attached to vibrating bars, or to be received into pockets, with the spiral springs, which are so graduated in length as to be successively brought into action, according to the bearing of the load, as described."

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7. For a method of operating the working *Valves of Steam Engines;* John Wilder, city of New York, January 9.

An arrangement of levers for working the valves of steam engines, is to be made within the steam chest, and these are to be operated by the rod. The valve has a conical seat, and may work on a stem to insure its working truly. The main lever is jointed at one end to the

lifting rod, and at the other to the centre of the valve; and at its middle to a second lever which embraces it, and which has its fulcrum in a line with the joint, which unites the first lever and lifting rod, when the valve is closed.

The claim is to the "combination of the lifting rod, principal lever, and the second lever, with the eduction valve."

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8. For an *Hydraulic Wheel for Raising Water;* Pierre Désiré Henry, city of New Orleans, Louisiana, January 9.

This wheel is a modification of the well known hydraulic wheel for raising water, which receives the water in bent tubes at the periphery, and discharges it near the centre. It is to be made much narrower at the periphery, where the water is received, than near the shaft, where it is discharged. The space between its inner and outer peripheries is divided into compartments by partitions tangential to the inner periphery. These compartments are made to open at both ends; the openings at their outer ends, or at the outer periphery of the wheel, are provided with valves opening inwards, to admit the water when submerged, and to prevent its escape when leaving the reservoir, or lifting the water contained in the compartment. The water is to be discharged into a proper reservoir, or gutter. When the wheel is employed to raise water from a shallow place, a spoon or scoop is adapted to its outer periphery to catch the water.

The claim is to the "arrangement of the tubes or compartments for conducting the water to the gutter, in combination with the valves governing the inlets of the compartments; and also, in combination therewith, the spoons or scoops for scooping the water up when the basin is low."

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9. For improvements in *Railroad Cars;* John A. Whitford, Saratoga Springs, New York, January 20.

The claims made under this patent refer throughout to the drawings.

The first improvement claimed is to an arrangement of parts by which the two trucks of a car are connected with each other, and with two windlasses, one at each end of the car, by means of which the axles of the wheels are to be thrown in the direction of the radii of the curve of the road. Each truck is provided with two racks that mash into two pinions, one on each side of the car frame; from the axis of each of these pinions extends an arm, to the outer end of which is affixed a chain that passes around the drum of a windlass at each end of the car. By turning either of the windlasses the axles are thrown out of their parallelism, and as the two trucks are connected by the racks with the two pinions, when one axle is shifted the other is shifted also.

The second improvement claimed is to the making of the axles in two parts, which are coupled together in the middle by means of a pipe, or ferule, in combination with a mode of adjusting them by

means of a pointed screw passing through a slide in each box, the head of which is cut into ratchets to prevent it from turning, a spring pall being applied thereto.

The third and last improvement claimed is in the combining two additional bow springs with the common spring. The two additional springs are arranged under the truck frames, one forward, and the other back of the pedestal, the ends bearing against the under side of the frame, and a bolt passing through the middle of each, and the side piece of the truck, and made fast to the ends of the main spring above, which bears on the boxes of the friction rollers that slide in the upper part of the pedestal—this car being so arranged as to have the bearings of the axles run on friction wheels.

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10. For a *Shingle Cutting Machine;* Truman Walcot, Stow, Middlesex county, Massachusetts, January 20; patent dated the 5th of September, 1840.

The improvement described in this machine consists in an arrangement of the parts of the carriage, by which the block is fed up to the knife at every upward movement of the knife gate. From the back of the carriage project two "toothed gauges," the teeth of which engage, alternately, with two *shippers*, which are connected with, or relieved from, the teeth of the gauge by two cams on the arbor of a ratchet wheel, which is turned by the gate at each upward movement. When the shippers are relieved from the cams they are drawn back against the teeth of the gauges by a spiral spring.

The claim is to the "combination of the ratchet wheel, cams, shippers, and toothed gauges."

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11. For an improvement in the *Seed Drill, or Corn Planter;* Calvin Olds, Marlborough, Windham county, Vermont, January 20.

This machine resembles a wheelbarrow, excepting that the shafts extend beyond the wheel to receive the necessary apparatus for forming the drill, &c. The circumference of the wheel is to be equal to the distance between the hills, it being provided with a projecting piece to mark the hills. On the axle of this wheel is another of less diameter, called the cup wheel, it being provided with a cup to receive the seeds from a shoe, or hopper, and discharge them into a spout, which drops them in a drill directly in front of the marking wheel. The cup wheel is movable on the axle of the dropping wheel, for the purpose of adjusting the two, to insure the marking of the place where the seeds have been dropped.

Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the cup wheel on the axle of the marking wheel, so as to render it adjustible, as described."

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12. For an improvement in the *Argand Lamp;* Benjamin Hemmenway, Roxbury, Norfolk county, Massachusetts, January 20.

The object of this improvement is to avoid the necessity of remov-

ing the oil chamber, in the fountain lamp, to replenish it with oil. The fountain or reservoir is supplied with oil through a short pipe at top, which is hermetically closed by a leather valve and screw cap; and between the bottom of this reservoir and the pipe that conducts the oil to the burner, is an air chamber, which is supplied with air by a tube passing up through the oil reservoir. From the bottom of the oil reservoir a tube, provided with a stop cock, descends to within a short distance of the bottom of the air chamber. When the oil chamber is to be replenished, the stop cock, in the tube at the bottom, must be closed, and the valve at the top may then be opened to receive the oil; and when the valve at the top is closed, then the stop cock may be opened. When this has been done, it is evident that the air from the air chamber will rise in the tube, at the bottom of the reservoir, and allow the oil to descend in the air chamber until it reaches the lower end of the said tube, and the oil reservoir being then hermetically closed by the valve at the top, the atmospheric pressure will prevent the farther descent of the oil. By this arrangement the inconvenience arising from the overflowing of the common fountain lamp is effectually guarded against, for by making the top of the burner a little higher than the lower end of the tube in the bottom of the oil reservoir, the oil can never rise above the given height.

Claim.—"I claim combining with the air chamber, in the manner set forth, a tube for admitting air to said chamber, and a stationary fountain or reservoir for containing oil, constructed as described; that is, having a tube to admit of a supply of oil when necessary, with a cap adapted to said tube, to exclude the pressure of the air, and a tube for conveying the oil to the air chamber, provided with a stop cock to intercept the communication while the fountain is being filled."

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13. For a *Safety Barge and Army Boat;* Solomon C. Batchelor, Cincinnati, Ohio, January 20.

For Specification, see vol. 1, page 114.

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14. For *Driving Machinery by the Foot;* Aaron Clarke, Greenwich, Fairfield county, Connecticut, January 20.

The machinery described by the patentee, is intended for driving silk reels, and for performing any light work, by means of a horizontal band wheel, and bands communicating with the machine to be driven.

The foot by which the wheel is to be turned, is to be passed into a shoe, which is connected to a crank pin on the face of a wheel, in such manner as to enable the operator to turn the wheel, which amounts simply to working a crank, or winch, by the foot, instead of by the hand.

It seems that there was novelty enough in the device, according to the judgment of the patent office, to justify the affixing its seal thereto; but we apprehend that the utility of the invention will not be sufficient in amount to render the purchasers of rights very numerous.

The claim is to the combination of the pin on the horizontal wheel, the oval block, and the shoe attached thereto.

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15. For an improved manner of constructing *Railroad Car Bodies;* George S. Hacker, Charleston, South Carolina, January 21.

This car body is to be cylindrical, and the patentee says:—"I am aware that carriage bodies for transportation of the mails, have been made cylindrical and hooped; but when thus constructed, the parts could not be tightly drawn by driving the hoops, and therefore I do not claim this as my invention. But what I do claim as my invention, and desire to secure by letters patent, is the construction of the body of a railroad car in the form of a barrel, hooped in the manner and for the purpose described."

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16. For an improved *Door Spring;* Samuel Sawyer, Boston, Massachusetts, January 21.

The object of this improvement is to increase the force with which the spring shall act on the door, as it closes, instead of decreasing it, as is the case with the springs generally employed. This is effected by increasing the leverage of the mechanism on which the spring acts.

At the upper part of the door is a pin which turns freely in a case, and around which is coiled a spring, attached by one of its ends to the pin, and by the other to the case. From the upper end of this pin projects an arm, at right angles, the outer end of which is jointed to a bar connected with the frame of the door by a joint at its other end. By this arrangement the tension of the spring acts on the pin, the arm of which, by its connexion with the bar above named, gradually increases its leverage as the door closes, and gradually decreases it as it opens.

The claim refers throughout to the drawings, and could not be understood without them; it is limited to the particular arrangement of parts above indicated.

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17. For a method of *Manufacturing Balls of Caoutchouc,* or India Rubber; Edwin M. Chaffee, Cambridgeport, Middlesex county, Massachusetts, January 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of balls from caoutchouc, by chopping it fine or otherwise reducing it to small pieces, and separating and heating the same by throwing it into hot water, and afterwards pressing it in a mould constructed as above described."

The mould employed in this process consists of a hollow cylinder, the bottom of which is concave, and semi-spherical, and to said cylinder a piston is fitted, the lower end of which is also semi-spherical to correspond with the bottom of the cylinder. A hole is made in the bottom of the cylinder, and another through the piston, for the escape of

the water which is forced out in pressing. The proper quantity of the material being put into the mould, the ball will be readily formed.

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18. For improvements in *Corsets;* Elizabeth Adams, Boston, Massachusetts, January 21.

We make the following extracts from the specification.

"I do not intend my invention to be worn for the purpose for which the common corsets or stays are generally used, as it is larger both before and behind, and could not be worn in ordinary circumstances, without great inconvenience. It is to be applied to pregnant females, to support the protruded abdomen, and at the same time to allow of its increase in size, without any injurious increase of pressure, from time to time during the period of pregnancy. For this purpose I insert, in a proper manner, in the centre of the front of the corset, a wide steel spring or busk extending to the bottom of the same. The lower end of the spring or busk is curved, so as to readily to adapt itself to the distended part, and extends downwards a much greater distance than the busk of the common corset, or down to and beneath the very lowest part of the abdomen.

"On each side of the central busk is another spring or busk of less size. These latter springs are also slightly curved, in order to adapt them to the sides of the projecting abdomen. It will readily be perceived, from the peculiar shape of the several springs, that those parts of the body which are dilated during pregnancy, rest on and are supported by the same, and that any strain or weight falling upon the springs is conveyed to, and supported by, the shoulder straps.

"Steel springs, or strips of whalebone, are inserted in the body of the corset, and so secured as to support the projecting parts of the breast, and sides of the abdomen.

"Long slits, or openings, are made in the front of the corset, between the springs or busks; and these openings are secured together by lacings of common caoutchouc, or other suitable elastic cord or tape.

"I claim the combination, in a corset, of the front slits or openings, with the steel busk or spring, curved and shaped as described and represented in the drawings, so that while the said busk, in conjunction with the curved form, which it imparts to the bottom of the corset, serves to support the distended parts, the several slits in front allow the parts, as they enlarge, to expand outwards or horizontally; and the looseness of the corset above the abdomen, permits them to rise upwards when sitting or stooping."

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19. For a method of *Forming Ice;* Thomas B. Smith, St. Louis, Missouri, January 23.

The patentee says:—"My improved process for the rapid production of solid ice by the freezing of water, is dependent upon the well known fact, that a thin stratum of water when exposed to an atmosphere, the temperature of which is at, or below, thirty-two degrees of

Fahrenheit's scale, very rapidly becomes frozen. It is also a fact that after a thin sheet of ice has been formed upon the surface of water, the process of freezing proceeds but slowly, in consequence of the bad conducting property of ice for the matter of heat. Taking advantage of these laws, I proceed in the formation, or the making of ice, in the following way: I prepare a vat, or other suitable vessel, of wood, or other material, of any size that I may deem convenient, and this I place on a level, in such situation as shall best expose it to the freezing influence of the atmosphere. From any suitable reservoir I cause a portion of water to run into this vat, or other vessel, so as to cover the bottom thereof to the depth of an eighth, or fourth, of an inch, more or less, according to circumstances, and this water I allow to become completely frozen; when this has taken place, I in like manner supply another portion of water to be converted into ice. Proceeding in this way, I quickly obtain a thick stratum of ice, of perfect purity, if the water be pure, and of great solidity."

The vat, or reservoir, is described as being made with movable partitions, to form blocks of any desired size.

Claim.—"What I claim therein, and desire to secure by letters patent, is the manner herein described of rapidly forming thick sheets, or blocks, of ice, by the successive pouring of small portions of water into a vat, or other suitable vessel, allowing the same to freeze, and adding, in succession, fresh portions of water, as above set forth, until the process is completed."

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20. For a method of *Moving the Index on a Weighing Apparatus, or Scales;* Martin Robbins, Hollidaysburg, Huntingdon county, Pennsylvania, January 23.

These scales are a modification of that kind which indicates the increase of weight by elevating a weighted lever from a vertical to a horizontal line, the scale dish being suspended by a cord passing around a wheel on the axis of the lever. The drawings represent the figure of a man standing on a pedestal, between two columns, and the scale, or index, of pounds, &c., is marked on an arch based upon the columns. The two arms of the figure are the weighted levers, their axes being the shoulders, and having a wheel on each, to which is suspended the cords or chains that pass through the body and legs, and hold the dish, which hangs in the pedestal. A cord or chain passes from a wheel, on the axis of one of the arms, or weighted levers, to a wheel on the axis of the index, which axis is situated in the breast of the figure, and is the centre of the arch on which the index figures are engraved.

The claim refers to the drawings, but it is confined to the arrangement of the wheel on the axis of the index hand, in combination with the chain leading from it to the wheel on one of the weighted levers, "for causing the index hand to perform a semi-circle on the graduated arch for indicating the weight of the article to be weighed." This arrangement will make a very ornamental balance, but we are unable to perceive any feature of novelty in the apparatus which could au-

thorize the grant of a patent; the device may please the fancy, but in the general arrangement it does not differ from some other weighing machines, nor will it weigh accurately.

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21. For an improvement in the *Fire Escape;* Samuel Welsh and Thomas Linacree, city of Albany, New York, January 23.

In describing this machine the patentees say, "the machine or apparatus, which we have improved, is of that kind in which there is a box for containing persons, and such implements as they may need; which box, by the turning of a winch, may, by the power of those within it, be made to ascend, or slide up on a vertical shaft, to the height of twenty, thirty, or more feet. Said vertical shaft is, at its lower end, attached and braced to a piece of timber, which constitutes one of the axles of a carriage, upon which the apparatus is to be conveyed to and from a fire; the shaft, which is to stand vertically when in use, being then placed in a horizontal position."

The axle tree, of what are the hind wheels, when the shaft lies horizontally, is braced to the shaft on two sides by permanent braces; and to the other sides of the shaft are jointed two other braces, the lower ends of which are shod with iron, and are connected with the ends of the axle tree by adjusting bars. A pair of wheels are adapted to the other end of the shaft when it is moved from place to place. This apparatus is provided with a short ladder, with which to form a connexion or bridge between the box and a window; it has hooks also at each end and side, for greater safety to the persons ascending or descending. When the shaft is elevated the wheels are chocked by means of blocks that fit their peripheries.

Claim.—"Having thus fully described the nature of the apparatus which we employ to preserve the lives of persons, and to aid in removing property and extinguishing fires in buildings, it is to be understood that we do not claim to have invented this apparatus, so far as its general construction is concerned; but we do claim to have made certain improvements therein, by which it is rendered more convenient and efficient than it has been as heretofore constructed. We confine our claim to invention, therefore, to the particular manner of combining those parts thereof, by which it is held steadily when the shaft is being raised, and whilst it is in a vertical position; said combination consisting of the adjustable leveling bars, the movable braces, and the chock blocks, co-operating with each other in the manner set forth. We also claim the combining with such apparatus, the trough and ladder with the additional pulley for elevating and managing the same."

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22. For *Draughting and Cutting Ladies' Dresses, &c.;* Aaron A. Tentler, Philadelphia, Pennsylvania, January 23.

We shall not attempt to give a description, or the claims, in this instance, as they refer throughout to the several diagrams which are to serve as guides in the operation.

23. For a process of *Manufacturing Sulphate of Alumine;* Rudolph and Gustava Boninger, Baltimore, Maryland, Assignees of Max Joseph Funcke, of Eickelskamp, Prussia, January 23; granted for fourteen years from the 16th of November, 1839, the date of the English Patent.
(See Specification.)

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24. For an improvement in the *Corn Sheller;* John A. Whitford, Saratoga Springs, New York, January 23.

The kind of corn sheller to which the patentee refers, is that which shells the corn by means of a roller set with teeth, and working against a concave hung on springs, to yield to the different sized ears of corn. The improvement consists in the employment of a series of wheels, with teeth projecting from their peripheries, on a shaft which has its bearings in the concave. The teeth on these wheels work between the teeth of a comb attached to a plate projecting from the frame, the edge of which nearly touches the teeth of the main shelling roller. The shaft of the toothed wheels, or small sheller, has a pinion on its end, which mashes into a cog wheel, the shaft of which passes through the concave frame, and on which said concave frame vibrates, to enable the small sheller to vibrate with the concave whilst it receives its rotary motion from the cog wheel. The ears of corn are brought against the comb and plate, and there stripped of their grain, which passes out and descends an inclined board leading to a proper recepticle, whilst the cobs pass out at the side.

The claim is to the "arrangement of the lower or small sheller in the lower part of the concave, so that they shall yield together to different sized ears, as described, in combination with the upper or main sheller."

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25. For an improvement in the *Machine for making Bricks* from tempered clay; Thomas Conklin, Woodville, Wilkinson county, Mississippi, January 23.

The clay is to be mixed in a tub of the usual construction, the bottom of which is pierced with a long aperture, through which the mixed clay is forced into the moulds, as they are presented thereto, by a series of inclined arms, which are attached to the shaft of the mixing knives, immediately above the bottom of the tub. Below this bottom, the shaft of the mixing knives has a circular platform attached to, and revolving with it to receive and carry round the moulds, which are hooked on to an endless chain that passes around a drum on the above mentioned shaft, and around another at the outer end of the way on which the moulds slide. After the moulds have passed under the aperture through which they are filled, they are conducted under two weighted pressers that press the clay into them, and then under a wire striker that cuts off the surplus material. The way or platform on which the moulds slide, is provided with an inclined plane at the outer end, which lifts the moulds, and thus unhooks them from the chain.

The circular revolving platform that carries the moulds round under the tub, is pierced with large holes to allow the clay which drops from the tub and from the moulds, to fall through out of the way of the machine.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the before described arrangement of the endless chains to which the moulds are attached, and the way, guides, and inclined planes, in combination with the circular revolving platform; the mixing tub, inclined dischargers therein, pressers, striker and discharger for making bricks in the manner herein set forth—there being a continuous line of empty moulds made to pass under the discharging aperture in the bottom of the mixing tub, whilst at the same time a similar line of filled moulds are made to leave the aforesaid aperture, pressed, struck, scraped, and the moulds liberated from the chains by the inclined plane at the end of the way, and in combination therewith, the endless chain for supplying the clay as described."

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26. For a machine for *Heading Spikes;* Robert S. Harris, Wilmington, Delaware, January 25.

The proposed improvement is on the common jaws, employed to hold the spikes in heading them with a hand hammer. The jointed jaw is opened and closed by a toggle, which is connected above by a link with a spring to open the jaws, and with a treadle below to close them. In the hole of the griping dies there is a pin on which the point of the spikes rest to prevent them from driving through; this slides in a hole made in a rest which prevents it from descending too low, but permits it to slide up. The lower end of this pin is connected by a lever with the treadle, so that as the jaw is opened by the action of the spring, the treadle is drawn up, which, by its connexion, forces up the pin, and thus liberates the spike from the dies.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the jaw, toggle joint, and spring, for the purpose of throwing open the jaws as described, and these parts, thus combined, I claim also in combination with the treadle, rest or support, and the pin, with their connexions, for the purpose and in the manner specified."

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27. For an improvement in *Dampers or Valves in Chimney flues;* Normand Smith, Hartford, Connecticut, January 25.

We deem it sufficient in this instance to give the claim on which this patent rests, which is in the following words, viz:—"I am aware that chimneys have been supplied with valves or shutters in the throat or flue, for the purpose of regulating the opening in the throat, or entirely closing it, and therefore, I do not claim this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the peculiar manner in which I have applied the dampers or valves, so that they can be removed at pleasure without removing any of the fixtures, to which, or by which, they are attached, by having

the pivots of the valves drop into notches, made in the iron framing, which is attached, or let into, the throat or flue of the chimney, in which they are retained by the weight of the iron valves, but from which they can be removed for the purpose, and in the manner, specified."

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28. For *Working the Valves of Steam Engines;* Robert L. and Francis B. Stevens, New York city, January 25.

The improvement which is the subject of this patent, is in the manner of working the valves of steam engines, in which the steam is to be cut off and used expansively. The following is extracted from the specification.

"Engines in which the steam is cut off, have either a separate valve or else use the steam valves themselves for that purpose; when the steam valves are thus applied, the mode hitherto used for working them has been by means of a cam wheel placed on the main shaft of the engine, which, through the intervention of a rod and rock shaft, raises and lowers the valves at proper intervals, or by means of tapets placed on the lifting rods, or on the pump rods, which last method is commonly known and described as the hand gear."

"In our improvement, (the exhaust valves being worked by any of the several methods hitherto used for that purpose,) we raise the steam valves and lower them at any portion of the stroke of the piston, by means of a separate and independent crank or eccentric wheel, giving an alternate rotary motion to a rock shaft, which by means of two toes, placed on the opposite sides of its centre of motion, alternately raises and depresses each valve. When the toes are affixed to the rock shaft so that their faces are in the same straight line, as soon as the toe on one side of the rock shaft has lowered one valve, the toe on the opposite side of the shaft begins to lift the opposite valve; in this case one valve is not closed until the other begins to open, and the steam is not intercepted until the end of the stroke of the piston; but when the toes are fixed to the opposite sides of the shaft so that their faces are not in the same straight line, but are depressed to an angle less than two right angles, after the toe on one side of the rock shaft has lowered the valve, the rock shaft will revolve through a certain interval before the toe on the other side of the shaft begins to lift the opposite valve: during which interval neither valve being raised, the steam in the cylinder will be acting expansively."

"What we claim as our invention, is the combination of an additional and separate eccentric wheel to work a rock shaft to raise the steam valves, in combination with any of the several methods hitherto used for working the exhaust valves. We also claim the manner in which the toes are affixed to the rock shaft, so that the shaft is made to vibrate during a certain interval, without either toe communicating motion to either valve. We also claim the combination of the cog wheel and rack, in the manner set forth, for the more completely effecting our object."

The last improvement claimed, is for affixing a rack on the end of the eccentric rod, to work in a cog wheel on the end of the rock shaft,

as a substitute for the eccentric hook and arm, when it is desired to give a greater amount of motion to the rock shaft.

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29. For improvements in the *Barometer;* William R. Hopkins, Geneva, Ontario county, New York, January 27.

In this improved instrument, the range, or rise and fall, of the mercury in the tube is to be ascertained by weighing, instead of being indicated by the scale usually employed. The bulb end of the tube is provided with a sack communicating with the tube, which communication may be closed when desired, by a valve and screw. When it is desired to weigh the mercury, the valve leading into the sack is closed, the instrument placed horizontally on a knife edge attached to the tube, and a scale dish suspended from the end of the tube opposite the sack.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of ascertaining the weight of the mercury in the barometer tube, by weighing the quantity remaining in the reservoir or cistern of the barometer. I also claim the sack and valve in combination with the barometer tube, by means of which the flow of mercury can at any time be arrested for the purpose of weighing."

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30. For an improvement in the *Corn Sheller;* Charles Willis, Chelsea, Suffolk county, Massachusetts, January 27.

This corn sheller is one of that kind which have a shelling wheel or disk furnished with teeth on both faces, and having two holding spouts; the improvement consists in having two plates, one on each side, which form the bottom, or rather, back of the holding spouts, and against which the ears of corn are borne during the operation of the shelling wheel. These plates are movable and adjustable by means of screws, so as to regulate the distance between their inner edges and the faces of the shelling disk.

The claim is to the "movable plates placed in the rear of the holding spouts, and capable of being adjusted by screws to such distances from the teeth of the rotary circular plate, as may be desirable, as described."

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31. For an improvement in the manner of forming *Blocks of Wood for Paving Streets;* James H. Patterson, city of New York, January 27.

The patentee says—"I cut my blocks rectangularly, or nearly so, in all their parts, and adapt them to each other in such a manner as that they shall interlock, and that no single block in the series which crosses a road, or street, can be pressed down without depressing the whole series; thus distributing the weight which bears upon them in one part, over the whole number. Under the arrangement here indicated, the blocks interlock on those sides only which are in contact with each other in crossing the road or street."

"What I claim as constituting my invention, and desire to secure by

letters patent, is the cutting of such blocks on two of their sides, so that they shall have four, or more, rectangular offsets, as herein described, when said blocks are intended to support each other in a straight line only, crossing the road, or street; and as it will be manifest that the principle upon which I shape my blocks may be carried out by forming a greater number of rectangular faces and off-sets, I do not intend to limit myself in this particular; but I am confidently of opinion that any change in these particulars would only render the plan of contruction more complex, without being productive of any advantage."

32. For an improvement in the *Domestic Spinner* for Spinning Wool; John Nelson, Jefferson, Logan county, Ohio, January 27.

This patent is obtained for an improvement in the arrangement of the parts of the well known family spinner for spinning wool, and which works on the principle of the old spinning jenney. The drawing carriage has the usual rollers, apron, and clamp for measuring out the length of roving at each operation. One of the rollers has a pinion on one end, which turns freely on its axis, in one direction, and in the other carries the roller around with it by a ratchet wheel and pall. As the carriage advances towards the spindles in winding on, the ends of the spring clamp are thrown open by two wedge pieces on the frame, and then kept open by a catch; during this, the pinion on the end of the roller is passing under a rack, attached to the frame, and turning freely on its axis, but when it changes its motion and runs back, then the roller is turned by the rack and pinion which gives out the roving, the length of which is regulated by the adjustment of a trigger which disengages the catch on the clamp, and thus arrests the farther supply of roving.

Claim.—"What I claim, is the manner in which I have constructed the clamp and its appendages, making a part of the carriage, and arranged the respective parts thereof, as described, so as to be operated upon by the rack, the wedge pieces, and the trigger, in the manner, and for the purpose, set forth. I do not claim the manner of constructing the clamp, the pinion or ratchet wheel, or either of the parts taken alone, but only in their combination with each other, in the manner set forth."

33. For an improvement in the *Curriers' Beam;* Ichabod Lindsey, Charlestown, Middlesex county, Massachusetts, January 27.

The wooden beam usually employed by morocco dressers and curriers, is rendered uneven by the action of the tanning liquor, and of the knife; and to obviate these difficulties, the patentee has substituted a slab of marble, metal, or other hard substance, for the wood heretofore employed.

The claim is to the "method of constructing curriers' beams by inserting a slab of marble, or other hard substance, in the wood, by which means the utility of the instrument is greatly improved."

34. For a *Fire Alarm ;* Theophilus Goodwin, of Exeter, New Hampshire, assigned to Josiah Brown, Brentwood, New Hampshire, January 30; antidated July 30, 1840.

The above named invention is for giving an alarm in case of fire in a house, by the expansion of a bar of metal, which is to start the trigger of an alarm bell.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the employment of the expansion of metals by heat to start an alarm in case of fire, in the manner and for the purpose described, using any of the solid metals, and applying them in any shape to produce the same effect."

A patent was granted to Rufus Porter on the 28th day of December, 1840, for an apparatus similar to this, but upon a hearing of testimony before the Commissioner of patents, the priority of invention was decided in favour of Mr. Goodwin, and the above named patent was therefore granted to him.

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35. For an improvement in the *Ink Stand;* Isaac M. Moss, of Philadelphia, Pennsylvania, assignee of John Farley, Washington, District of Columbia, January 30.
(See Specification.)

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36. For an improvement in the manner of *Discharging Fire Arms ;* Joshua Shaw, January 30.
(See Specification vol. 1, p. 117.)

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37. For an improvement in the *Brick Press ;* Thos. W. Smith, Alexandria, District of Columbia, January 30.

The brick to be pressed is placed upon a horizontal sliding table, which sustains a system of progressive levers of the kind usually denominated the toggle joint, by which the pressing is to be effected. The sliding table is carried forward by a rack and pinion beneath it, and the whole apparatus is arranged in such a manner as to render it both efficient and convenient. Although not complex, it would not be easy to describe its construction intelligibly without the drawings, and we will, therefore, only give the claim, which is to " the forming of the pressing mould by means of the frame, the sliding table, and the standard and follower thereon, constructed and operating as set forth. Likewise, in combination with such a machine, the distinct and independent manner of pressing the brick, and of carrying the brick forward into the pressing mould, and removing it therefrom, the whole being constructed and operating substantially as described."

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38. For an improvement in the *Gridiron* for broiling meat; Isaac Damon, Northampton, Hampshire county, Massachusetts, January 30.

This gridiron is of the usual square form, and instead of the bars

and open spaces, it is made of a crimped, or corrugated metal plate, without openings. At the back there is the usual dripping pan, and a fender is placed immediately in front of it to protect the gravy from the action of the fire.

Claim.—"What I claim as my invention and improvement upon the common gridiron, and desire to secure by letters patent, is the employment of the crimped metallic plate, instead of bars or open spaces, and also, of the fender between the dripping pan and the fire, as described."

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39. For an improvement in the *Machine for Stretching Horse Collars;* James P. Osborn, Reddington, Hunterdon county, New Jersey, January 30.

This machine consists of a metal stock, on which the collar to be stretched is put; the stock is made in two parts, which are hinged together at the larger end; and within this is placed a wooden *form*, which slides upon the bench, by the aid of a screw rod and crank. A rope is passed around the collar after it is placed on the metal stock, and is made fast to a nut that travels on another screw rod, provided with a crank. By turning the two screw rods, the two sides of the stock are forced out by the sliding of the wooden *form* within it, whilst at the same time, every part of the collar is made to hug, and take the form of, the stock by drawing of the rope.

The claim is to the "combination of the metal stock, the movable wooden form, the manner of using the rope, and the cranks and screw rods."

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40. For improvements in the *Carding Machine;* Ebenezer and Alanson Crane, Lowell, Middlesex county, Massachusetts, January 30.

The top cards instead of being permanently attached to the frame, are affixed to a traveling endless belt, passing around a roller at each end, and one at top in the middle—they are prevented from approaching too near to the main card by a segment plate, over which the ends of the pieces, forming the chain, travel. As the top cards approach the top roller, they are stripped by a stripping card attached to the ends of two "sweeps," or arms, that receive a reciprocating motion from a crank. After stripping the top cards, it passes over a small permanent card which cleans it.

The rollers and segment are provided with adjusting screws.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the attaching or fastening the top cards of the carding machine to revolving endless chains or belts, instead of securing them to the frame of the machine, and making them stationary as heretofore practiced, as described: and the application of such belts in combination with the rollers and adjusting screws and segment of a circle, to the purpose of conveying the top cards of the carding machine to, and placing them in, a position where they can be stripped by power, and the combination of the sweeps and stripping and clean-

ing cards, and crank for the purpose of stripping the top cards by power, when placed in such position as described."

41. For an improvement in the *Endless Chain Horse Power;* Jeremiah M. Reed, Middlefield, Otsego county, New York, January 30.

The endless floor of this machine is formed by the union of a sufficient number of four wheeled cars, the wheels of which travel round in the space formed by two endless railways on each side, the space being a little wider than the diameter of the whole. The cars are connected together by links jointed to their bottoms. Motion is communicated to a shaft by racks attached to the bottom of the cars.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the endless chain upon which the horse, &c., walks by uniting together in the manner described a sufficient number of four wheeled cars, as described, and also running the wheels in the space between the two endless rails on each side, in the manner described."

Specifications of American Patents.

Specification of a Patent granted to James C. Booth, *of Philadelphia, Pennsylvania, December 5th,* 1840, *for a mode of Whitening or preparing what is termed "Fair Leather."*

Be it known that I, James C. Booth, of Philadelphia, Pennsylvania, have invented a new and improved mode of manufacturing, preparing, whitening, or making, what is termed "Fair Leather," and I do hereby declare that the following is a full and accurate description.

In order to obtain or put the leather in the state designated, so that it may have the peculiar light-colored and fair appearance which is the object of the invention, I employ it (the leather) in that stage of the manufacture when it is in its moist state, after it is "finished;" or if it is used when the leather is dry, then in the latter case it must be moistened through with clear water. While it is thus wet, I spread with a sponge, brush, or other suitable article, the following liquid composition over the fair surface of the leather, giving it sufficient dampness to let the pores absorb the liquid. The liquid to be applied, is a solution of the protomuriate of tin in muriatic acid, ether, alcohol, and water, and is composed as follows:—Any quantity of the protomuriate of tin is dissolved in about one half of the weight of muriatic acid, and to this solution ether is added in the proportion, by weight, of three times the weight of the protomuriate of tin, and then a quantity of alcohol by weight, equal to four times the weight of the protomuriate of tin. To this may be superadded clear fresh water in the proportion of three parts by weight, as compared with the protomuriate of tin.

If the leather to be employed under this process is not clear, or is very dark, or spotted, then a greater proportion of muriatic acid is to be used, say an equal quantity, by weight, or twice as much, by

weight, as compared with the protomuriate of tin. Immediately after the application of the above described liquid composition to the leather, I spread over it, in a similar manner, spirits of turpentine with or without a small quantity of tallow, dissolved in it, sufficient to make it pliable, and the leather is suffered to dry in the ordinary manner, and the operation is complete. The spirits of turpentine, alone will generally be sufficient to give pliability to the leather after the first composition is employed, without adding the tallow, but when the leather is stiff or hard, or not sufficiently soft, the tallow may then be added. The leather after this process will have the required whiteness and fair appearance.

What I claim as my invention or discovery, is the use of the protomuriate of tin dissolved in the manner, and by the liquid, above described, for the purpose of communicating a light-colored and fair appearance to leather, whether the leather be oak tanned, bark tanned, hemlock tanned, with its natural or ordinary color.

James C. Booth.

Specification of a Patent for a Process of Manufacturing Sulphate of Alumine. Granted to Rudolph and Gustava Boninger, *of Baltimore, Maryland, Assignees of* Max Joseph Funcke, *of Eichelskamp, Prussia, 23rd of January,* 1841*; patent to run fourteen years from the* 16*th of November,* 1839*—the date of the English patent.*

To all whom it may concern: Be it known that I, Max Joseph Funcke, a subject of the King of Prussia, residing at Eichelskamp, in the circuit of the government of Dusseldorf, in the said kingdom, have invented an improvement in the manner, or process, of manufacturing sulphate of alumine, so as to produce the same free, or very nearly free, from iron, and from alkali; whereby it is more perfectly adapted to be used as a mordant, or for other purposes, in the useful arts, than the alum of commerce, or than the sulphate of alumine, as ordinarily prepared. And I do hereby declare that the following is a full and exact description thereof.

I take potters' clay, pipe clay, or clay of any other kind, as free from iron as it can possibly be obtained; and this I dry at such degree of heat as is necessary to drive off all its free moisture. The clay so calcined, is next to be reduced to powder, and this powder I put into suitable leaden vessels, or vessels of other material not acted upon by sulphuric acid; to these vessels a moderate degree of heat is to be applied, by means of steam or otherwise. Sulphuric acid, of 66° Beaumé, is then to be added to the clay, in such quantity as shall suffice to dissolve nearly the whole of the alumine contained in the clay; which may be ascertained by a previous test on a small quantity. An excess of acid should not be used, as the whole ought to be perfectly neutralized by the alumine.

After the addition of the acid, the mass in the pans is to be stirred until it is perfectly dry; boiling water is then to be added in sufficient

quantity to dissolve the whole of the salt. The liquid thus obtained is to be placed in vats, and to remain at rest until it becomes perfectly clear. It should then be tested by means of lime water, to be certain that it does not contain any free acid; and should any be present, lime water is to be added until the whole excess of acid has combined with the lime, and has been precipitated in the form of sulphate of lime. When perfectly clear, the liquid is to be drawn off into other vats, preparatory to the separating from it the iron, which will always be found contained with it in greater or a less quantity. A measured portion of this liquid, say one pint, is then to be taken, and the iron contained in it is to be precipitated, by means of a solution of prussiate of potash, in such manner as to ascertain the exact quantity of said solution necessary to the precipitation of the contained iron. The quantity of liquid contained in the vat being known, the portion of the solution of the prussiate of potash necessary to the precipitation of the whole of the iron will consequently be known, and this is to be added to it, the mixture stirred, and the prussiate of iron formed, allowed to go to the bottom. The liquid is then to be drawn off clear from the precipitate, and a pure, or nearly pure, solution of sulphate of alumine will be thus obtained; and it may in this state, be applied to various purposes in the arts.

If desired, the water may be quickly evaporated in leaden or other vessels, until a pellicle appears on its surface; when it may be put into suitable forms, and allowed to cool and crystalize, or consolidate.

I am aware that clay has been heretofore treated with sulphuric acid, to form a sulphate of alumine; and I am also aware that it is known to every chemist that iron may be precipitated from its solutions in sulphuric, or other acid, by means of prussiate of potash. I do not, therefore, make any claim to the discovery of either of these processes when taken alone; but I do claim the combination of means herein pointed out for the manufacturing of sulphate of alumine, by which it is produced with greater facility, and in a state of greater purity, than by any of the processes heretofore adopted in its manufacture; that is to say, I claim, in combination, the preparing of the clay by dessication, the combining thereof with sulphuric acid, and the subsequent solution and precipitation of the iron, substantially in the manner, and for the purpose, herein fully made known.

I will here observe, that although I have pointed out a solution of the prussiate of potash as the article by which the iron is to be precipitated, I have done so because I esteem this as the best mode of obtaining the end desired; but I do not intend hereby to limit, or confine, myself to the use of this salt, but to use any other of the known reagents by which a similar result may be attained, and a sulphate of alumine free, or nearly free, from alkali, may be produced.

MAX JOSEPH FUNCKE.

Specification of a Patent for an improvement in Ink Stands. Granted to ISAAC M. MOSS, *of Philadelphia, Assignee of John Farley, Washington, District of Columbia, on the 30th of January,* 1841.

To all whom it may concern: Be it known that I, John Farley, of Washington, District of Columbia, having invented a new and improved mode of using ordinary writing ink, and hereby declare the following to be a full and exact description.

The nature of my invention is such as to accomplish all the desiderata in writing: such as facility in the use of the ink, purity in the fluid, preservation from moulding, &c., by the employment of capillary attraction in the following manner, viz:—I provide the stand with an air tight stopper, which screws into the top and centre of the stand. In the centre of this stopper is a small funnel, or reservoir, communicating by an aperture with the interior. Through this aperture I insert a wick, possessing the capillary property of the sponge. The stopper being screwed down, causes the ink to rise in the reservoir for use, in a pure and limpid state, and by reversing the motion, the ink falls at pleasure, and is secured from deterioration or accident. The capillary action being an independent effect, per se, will result with or without the intervention of a tube.

What I claim as my invention, and desire to secure by letters patent, is the employment of a capillary action for the purpose of supplying the ink, as herein described, in combination with the air tight stopper, arranged and operating as above set forth.

JOHN FARLEY.

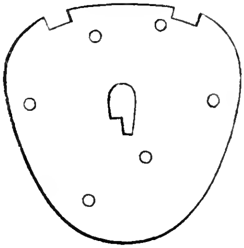
Specification of a Patent for an improved Padlock, called the Clam Shell Padlock. Granted to SOLOMON ANDREWS, *Perth Amboy, New Jersey, December 5th,* 1840.

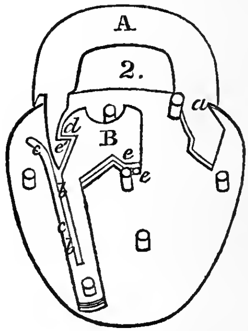
To all whom it may concern: Be it known that I, Solomon Andrews, of Perth Amboy, in the county of Middlesex, and state of New Jersey, have invented an improvement in the manner of constructing padlocks, which improved locks I denominate the clam shell padlock, and which is particularly applicable to mail, and other traveling, bags, although it may also be used for other purposes; and I do hereby declare that the following is a full and exact description thereof.

The distinguishing features of the lock, are the manner in which I construct, or form, the shell, or case, within which the key operates upon what I call the spring hooks; the manner in which I form these spring hooks, and also the way in which I connect the bow, or hasp, with the shell, or case, without the employment of a joint pin. The shell, or case, consists of two plates, or pieces of metal, only, which are struck up in the same die, and are, therefore, exactly alike in form. Fig. 1 represents one of these plates, which when laid upon, and riveted to, a corresponding plate, forms the shell, the edges of which are curved, or rounded.

Fig. 2 shows the interior of the lock, the key-hole plate, fig.1, being removed. A is the bow, or hasp, which is embraced at its joint part by the sides of the shell, and is thereby held in place, the part which enters the notch at *a* serving as the fulcrum upon which it turns; it is thus left solid, not requiring to be perforated for a joint pin. B is one of the spring hooks; of these I generally employ from four to six, placed one above the other; but any desired number may be used. I usually cut each of these spring hooks out of a single plate, with a slit, *b*, *b*, along it, so as to constitute the part *c*, *c*, a spring which admits the catch of the hasp to come under the hook when the hasp is shut, or pushed in, and hold it there until it is released by the key; and when the key forces the hook, or catch part, *d*, back, it will cause the upper end of the spring to bear against the inclined portion, *é*, of the catch of the hasp, and will cause the hasp to fly out, as soon as it is relieved from the action of the catch part of the spring hooks. The side of the key bits, (which may be of different lengths,) when turned open the lock, bears against the lips, *e*, *e*, of the spring hooks, to each of which they are adapted and fitted in a way well understood by locksmiths. When the key is not acting upon the spring hooks, or the hasp is not being pushed in so as to be held by the catch, there is no tension whatever on the spring, *c*, *c*, but it is quite free, exerting no pressure at all on the catch.

Fig.1.





Having thus fully described the construction and operation of my improved mail bag padlock, what I claim therein as constituting my invention, is: first, the forming of the shell, or case, of two pieces of plate metal, raised, and adapted to each other, in the manner set forth. I do not claim the raising of metals by means of dies, this being a well-known process, but I limit my claim to the manner in which I have adapted the raised plates to the forming of the shell of a padlock, instead of making it by casting, or by joining a rim on to wrought metal; as by this adaptation I have not only improved the form, but have given additional strength, and that at a diminished cost. Secondly, I claim the manner of combining the bow, or hasp, with the shell of the lock, without the use of a joint pin, as herein fully set forth. Thirdly, I claim the manner of forming and using the spring hooks, as described; the springs being so arranged as to be

brought into action by the shutting of the hasp, and by the turning of the key, and causing the hasp to fly out, by the pressure of the springs against the inclined point of the catch.

It will be manifest that variations may be made in the manner of forming and arranging the respective parts of the lock herein described, and I do not, therefore, intend to limit myself in this respect; the springs may be made separate, and attached to the spring hooks; and other changes of a similar kind may be introduced in other parts, whilst the instrument will remain substantially the same, producing a like result by analogous means.

SOLOMON ANDREWS.

English Patents.

Specification of a Patent granted to JOHN WILLIAM NEALE, *of Kennington, and* JACQUES EDOUARD DUYCK, *of Old Kent Road, for certain improvements in the Manufacture of Vinegar, and in the apparatus employed therein, September 8th,* 1841.

These improvements consist in the manufacture of vinegar from beet-roots; these roots, after being thoroughly washed, are reduced to the state of pulp by rasping. A number of strong cloth bags are filled with this pulp and placed in a press with a board or hurdle between them, and subjected to a powerful pressure, till the whole of the saccharine juice is extracted. The juice, which will vary in strength from about 7° to 9° of the areometer, is to be reduced to 5° by the addition of water, and boiled; the liquid is then removed to the coolers. On the temperature falling to 60° Fahr., the wort is removed to the fermenting vat, and half a gallon of yeast added for every 100 gallons of wort.

When the fermentation is over, the liquor is removed to the acidifying vessel, which is a strong vat capable of holding 24,000 gallons; in its centre, at a short distance above the bottom, there is a perforated rose, communicating by a pipe with a blowing machine. A steam worm lies at the bottom of the vat, communicating with a boiler, and furnished with a stop-cock, the other end of the worm being open to the atmosphere. The vat is divided into several compartments by perforated diaphragms, and in the cover of the vat there is a valve opening upwards.

Two thousand gallons of vinegar are first let into the vat to serve as mother to an equal quantity of fermented wash, which is next introduced, with a little yeast, when acetous fermentation quickly ensues. Air is then forced in through the perforated rose, which in its passage through the perforated diaphragms enters into intimate contact with the liquor, imparting a portion of oxygen to it, and expelling the carbonic acid gas through the valve in the vat cover. When the temperature of the liquor falls below 70° Fahr., steam is admitted to the worm, so as to maintain the temperature constantly between 70° and 80.°

In a few days the liquid will be converted into vinegar, when 4000 gallons more of fermented wash are let into the vat, and the process continued until the whole 8,000 gallons become vinegar. This course is pursued until the vat contains 24,000 gallons of vinegar, when 8000 gallons are drawn off and clarified, and replaced with 8000 gallons of fresh wash, and so on continuously.

The claim is—1. To the improved process and apparatus for manufacturing vinegar from beet-roots.

2. The process and apparatus for effecting and maintaining the acetous fermentation, and all such modifications of the same, wherein the acetous fermentation is conducted by the combined operations of an air-forcing apparatus and steam-heat applied in pipes or vessels within the acidifying vessel, whether the process of conducting the acetous fermentation be applied to the making of vinegar from beet-roots, or any other substances.

3. To the application of an air forcing apparatus in the manufacture of vinegar, or acetous acid, distinctly considered from the other parts of the apparatus. Lond. Mechanics' Mag.

Specification of a Patent granted to WILLIAM SAMUEL HENSON, *London, for certain improvements in Steam Engines, August 16th,* 1841.

In this high pressure condensing steam-engine, the steam chambers are each furnished with an escape-valve closed by a spring; these valves are kept shut by rods and levers worked by cams on the main shaft, the pressure of which is withdrawn when the valves are to be permitted to open. Thus, supposing the piston to be near the completion of its downward stroke, the pressure is removed from the upper escape-valve, when the steam forces it open, and rushes out until the steam within the cylinder is reduced to a slight excess above atmospheric pressure, when the spring closes the valve; the upper eduction-valve is now opened, and the remainder of the steam passes into the condenser. The piston then makes its upward stroke, and the opposite set of valves act in a similar manner.

The engine is furnished with two condensers, each having a valve at the top opened by rods worked by the engine; and also a valve at bottom kept shut by a spring, but opening into a casing, which communicates by a valve opening outwards with a cold water tank. Each condenser is provided with a jet, and is inclosed in a separate cistern, having a side valve for the admission of cold water, and two valves in its base through which the water is conveyed into the casing, and thence back into the cold water tank. At the termination of a stroke, the steam is admitted through the eduction-pipe into a chamber above the condensers; the upper valve of one of the condensers being opened, the steam enters and forces out the condensation water of the previous stroke through the lower valve, escaping with it, until the steam in the chamber is in equilibrium with the atmosphere, when the spring closes the lower valve.

The upper valve of the other condenser is now opened, and the remainder of the steam admitted and condensed by the injection of cold water, producing a partial vacuum within the condenser. During these operations, the cistern of the latter condenser is filled with water, while the former is empty. Towards the termination of the succeeding stroke, the water is allowed to run off from the latter cistern, by opening its lower valve, and the jet is turned off: at the same time cold water is admitted into the cistern of the first condenser and its jet turned on. The same operations as before then take place, the order of the condensers only being reversed.

In order to guard against explosion, the patentee places a governor on the top of the steam boiler,which is connected with the safety-valve by a long lever, in such a manner, that while the engine is at work, and the governor in motion, the safety-valve is closed, but as soon as the engine stops, the governor opens the safety-valve and lets off the steam.

The claim is—1. To the application to the cylinder of a steam-engine using a condenser, or to the passages between the cylinder of a steam-engine and its condenser, of an apparatus of the nature of that described, so as to permit the escape from the cylinder, or from the steam passages between the cylinder and the condenser, during a very short interval of time near the termination of each stroke, of so much steam as will leave the remainder of the steam within the cylinder but little above atmospheric pressure, and condensing that remainder by the means ordinarily used in condensing engines.

2. To the clearing the condensers of steam-engines, in which high pressure steam is used, by the application to that purpose of part of the force by which steam, used in such engines. exceeds the pressure of the atmosphere, when combined with condensers, at intervals immersed in water, as described.

3. To the application of a governor to the safety-valve of steam-engine boilers, by which the safety-valve is raised when the engine is at rest.

Ibid.

Specification of a Patent granted to John Godwin, *of Hackney Road, for an improved construction of Piano Fortes of certain descriptions. August* 23, 1841.

The improvements here patented relate to the construction and arrangement of the different parts of horizontal pianos, the strings of which pass from the plate over the bridge on the sound-board in the usual manner, and under a bridge beneath the wrest-pin block. The strings are each passed round a separate pulley, and are then carried up in front of the block to the wrest-pins, and are secured in the usual way. These pulleys are made in sets, according as the instrument is to have two or three unisons, and the mounting of each set has a shank attached to the lower angle of the front of the wrest-pin block, which is cut away for that purpose. The wrest-pin block is of a rectangular form, (eight inches wide, and four inches deep,) and

is composed of two pieces; the lowest of which is cut away to admit a strap on one end of a bar, the other end of which is attached to the string plate. There are several of these straps, which are let in to counteract the tendency of the tension of the strings to depress the front and elevate the back of the wrest-pin block. For this purpose, an iron bolt, three-sixteenths of an inch in diameter, is also passed through each bar, through the sound-board and bracket, and secured above the bar by a nut, and beneath the bracket by a washer.

The sound-board is placed three inches and a half below the strings, and is extended two inches farther than usual towards the front of the instrument, under the vibrating part of the strings. This extension may be carried through the whole length of the scale, but it is preferred to go only as far as where the treble notes do not require dampers.

In order to effect the action of the key upon the hammer and damper, under this arrangement, the damper level is placed between the sound-board and the strings, and the bracket is made quite straight. The key is shortened about two inches, and a right angled piece of metal, fixed on the end of it, communicates the action of the key to the damper lever. The check is carried farther back on the key, and a check piece is attached to the middle of the shank. The hammer rest is also removed higher up, and the length between the head and the shank of the hammer is reduced to an inch. Ibid.

Specification of a Patent granted to William Edward Newton, *of Chancery Lane, for improvements in obtaining a concentrated extract of Hops, which the inventor denominates "Humuline." August* 15, 1841.

The hops are dried till brittle in an oven heated to 86° Fahrenheit, and are then passed through a coarse sieve; this powder is placed in a close cylinder and covered with alcohol to a depth of one and a half inches, and submitted to pressure for twenty-four hours. The alcoholic tincture is then drawn off into a tub, and the powdered hops washed repeatedly in water, till no further extract remains in them.

The alcoholic tincture, and the essential oil which is combined with it, is placed in a water-bath, and the alcohol driven off, which leaves the essential oil remaining behind in the form of a brownish-yellow resin covered with a yellowish watery extract. This extract is added to the aqueous solution, and evaporated by an open fire to the consistence of sirop; it is then removed to the water-bath and evaporated to a nearly solid extract. This extract is added to the resinous matter of the alcoholic tincture in a warm state, and the compound thus produced is the "Humuline," two pounds of which are equal in use to six pounds of hops.

Another mode is to place hops, either powdered or whole, in a closed vessel, and expose them to the action of steam, when a liquid extract is obtained, which, by evaporation, may be converted into "Humuline."

The claim is to the methods herein described, of making or producing a concentrated extract of hops. Ibid.

Specification of a Patent granted to James Ransome and Charles May, *of Ipswich, Suffolk, for improvements in the Manufacture of Railway Chairs, railway and other pins or bolts, and in wood fastenings and tree nails. August* 15, 1841.

These improvements in the manufacture of railway chairs, consist in the employment of metal side plates in the sand mould in which the chair is cast; and also in using metal cores for the cavity in the chair which receives the rail.

The second improvement, relating to the manufacture of wooden pins or bolts, consists in forcing them into moulds, (which are cylindrical tubes slightly tapered towards the mouth,) and submitting them while under compression, to the action of heat, until the natural elasticity of the wood is sufficiently overcome. The pins will then retain the form thus given them until driven into damp sleepers, when the moisture will cause them to swell, and they will become firmly fixed therein. The wood fastenings and tree-nails are treated in a similar manner.

The claim is—1. To the mode of casting railway chairs by means of metal side surfaces in sand moulds, with metal or other cores as described.

2. To the mode of casting railway chairs, by applying metal cores as described.

3. To the mode of manufacturing railway and other pins or bolts, and wood fastenings and tree-nails, by forcing them into moulds so formed as to retain them under compression till the elasticity of the wood is sufficiently overcome.

4. To the mode of manufacturing railway and other pins or bolts, and wood fastenings and tree-nails, by subjecting them to heat when under compression, in moulds as described. Ibid.

Specification of a Patent granted to James Whitelaw and George Whitelaw, *of Glasgow, for a new mode of Propelling Vessels through the water, with certain improvements in the steam-engine when used in connexion therewith, part of which improvements are applicable to other purposes. August* 15, 1841.

This new mode of propelling, consists in forcing air through openings in the bottom of the vessel, which passes in divided currents along channels or spaces inclining upward from the bottom of the vessel toward the stern, where it escapes at the surface of the water. The propelling power is derived from the buoyancy of the air—the force which it gives out, as it expands in its passage to the surface of the water—and the force from reaction which is communicated to the

vessel as the air escapes. In order to back the vessel, the air is forced out through pipes directed towards the bow of the vessel.

The improved steam-engine consists of a horizontal cylinder through the centre of which a main shaft passes, carrying two vibrating vertical fans, which together fill the diameter of the cylinders, and greatly resemble a Bramah's pump. On one side of this cylinder is another of equal size, and similarly constructed, which forms the air-pump for propelling the vessel, while on the opposite side is the air-pump of the steam-engine. The shafts are all connected so as to move together. On admitting steam to the engine, the fans make a vibratory movement, each motion of the air-pump forcing a portion of air into the channel before mentioned, along which it passes in broken currents, which the patentees consider more advantageous than a continuous current of air. Ibid.

Specification of a Patent granted to Thomas William Booker, *of Melin Griffith's Works, near Cardiff, for improvements in the Manufacture of Iron. August* 21, 1841.

For the purpose of converting cast iron from its crude state, into wrought or malleable iron, an open refinery, or furnace, is connected with a reverberatory, or puddling furnace, by a passage which terminates in its neck. The refining furnace having been sufficiently heated, a charge of about nine hundred weight of cast-iron is thrown in, and melted down in the ordinary way; when the refining process is complete, the whole charge of metal is run off into the puddling furnace, previously heated to a proper degree. The iron is then puddled in the usual manner, and divided into lumps or balls of a convenient size, which are passed to the rolling cylinders, &c., to be finished.

The principal novelty in the process consists in causing the heated metal of the refining furnace to pass directly into a puddling furnace without being permitted to become cold. Ibid.

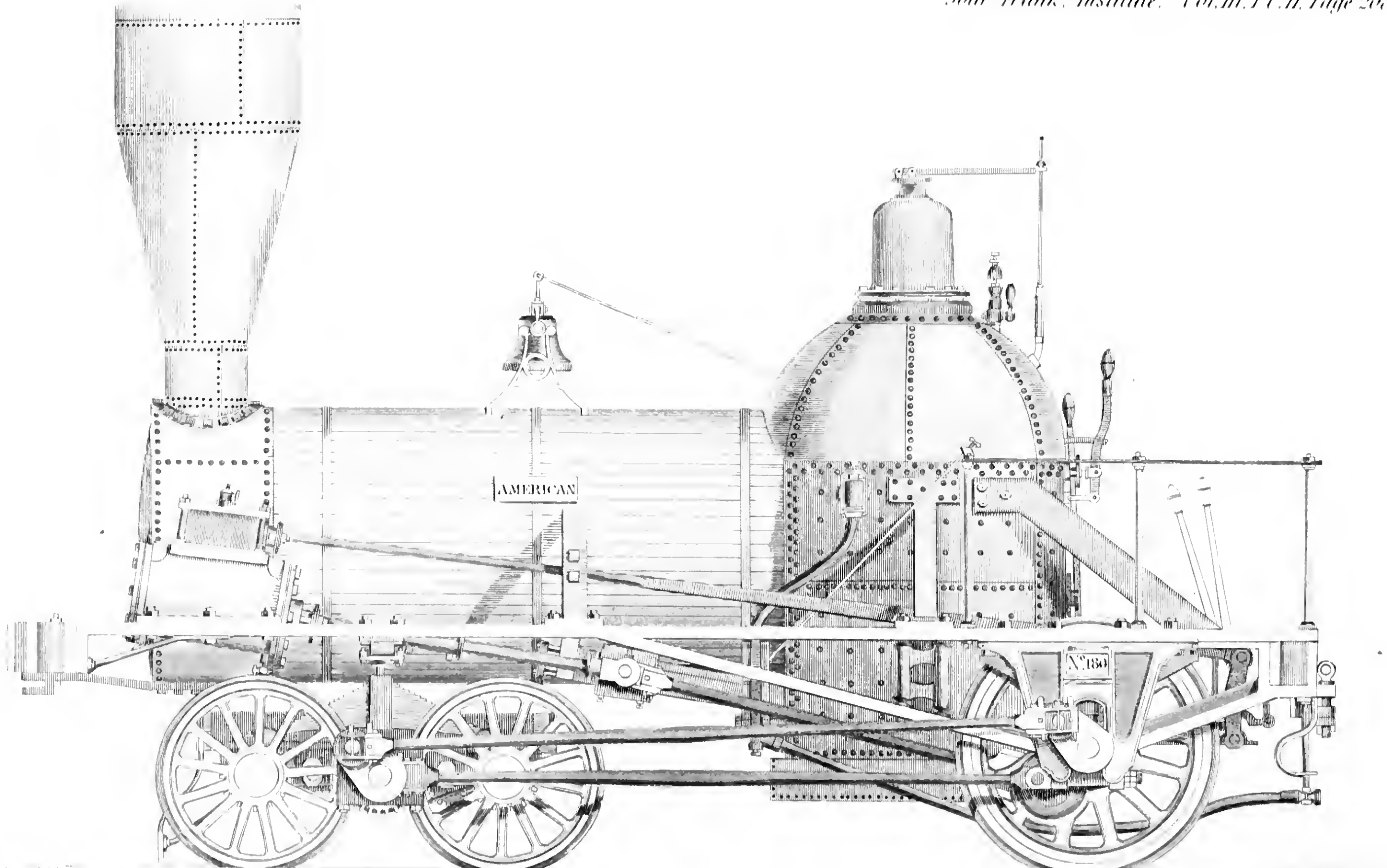
Progress of Civil Engineering.

Baldwin's Geared Truck Locomotive Engine.

Through the kindness of Mr. Baldwin, we are enabled to lay before our readers in the present number, an engraving of this new arrangement of the machinery of a Locomotive, by means of which, the wheels of the leading truck (so valuable in a curved way) are converted into drivers, without interfering with their other useful properties.

We also subjoin the letter of the Superintendent of the Reading railroad, describing a large performance made by this Locomotive on that railway; and at page 178 we insert the report of the committee of Science and the Arts, upon the merits of the peculiar arrangement of parts, by which the adhesion of all the wheels is obtained.*

* For the specification of Mr. Baldwin's patent, for the mode of accomplishing this object, see the number of this Journal for February, 1842, page 136.



Engraved by J. Yeager

Alfred Vail Del.

BALDWIN & VAIL'S ENGINE FOR BURDEN.

PHILADELPHIA, February 12, 1842.

Messrs. BALDWIN & VAIL; Gentlemen,—I send you inclosed, a statement of the performance of your new six wheeled, geared engine, which you will perceive is in every way satisfactory. The train weighed $108\frac{1}{2}$ tons, of 2,240lbs., more than that hauled by your "Hichens and Harrison" engine in February last, on our road.*

Statement of the performance of a six wheeled engine, built by Messrs. BALDWIN & VAIL, *on the Philadelphia, Reading and Pottsville Railroad, February* 12, 1842.

This engine has six wheels and outside connexions. The large drivers (forty-four inches in diameter,) are behind the fire box, and connected with the four truck wheels, (thirty-three inches in diameter,) by cog gearing, in such a way as to obtain the adhesion of the whole weight of the engine, with little additional friction, and at the same time allow the requisite play in curves.

Her weight, in running order, is 30,000lbs.; on her large drivers, 11,775lbs.; or 5,887lbs. on each. On the truck wheel 18,225lbs. or 4,565lbs. on each, and her cylinders are thirteen inches diameter and sixteen inches stroke.

This engine hauled, on the above date, a train of 117 loaded cars, weighing in all 590 tons, from Reading to the inclined plane, on the Columbia railroad, fifty-four miles, in five hours and twenty-two minutes, being at the rate of over ten miles per hour the whole way.

She consumed $2\frac{6}{10}$ cords of wood, and evaporated 3,110 gallons of water, with the above train. Weight of freight, 375 tons, of 2,240lbs.; consisting of 259 tons of coal, twenty-two tons of iron and nails, and ninety-four tons of sundry other merchandize, including fifty-three live hogs, ten hhds. of whiskey, 188 bbls. flour, ship stuff, butter, &c. Weight of cars, 215 tons, making a total weight, not including engine and tender, of 590 tons of 2,240lbs.

Whole length of train, 1,402 feet, or eighty-two feet over a quarter of a mile. The above train was transported in the ordinary freight business of the road, and was run without any previous preparation of engines, cars or fuel for the performance. The engine was closely watched at all the starts of the train, and not the least slipping of any of her wheels could be perceived. She worked remarkably well throughout the trip, turning curves of 819 feet radius, with ease to her machinery, and no perceptible increase of friction in her gearing. Her speed with the train on a level, was found to be nine miles per hour.

Whole length of level, over which the above train was hauled, twenty-eight miles; longest continuous level, $8\frac{1}{10}$ miles; total fall, from the point where the train was started to where it stopped, 210 feet.

The above train is unprecedented in length and weight, in Europe or America. G. A. NICHOLLS,

Superintendent of transportation on the Philadelphia, Reading, and Pottsville railroad.

U. S. Gazette, Feb. 14th.

* See the number of this Journal for May, 1841, page 319.

Cadwallader Evans' Safety Valve.

Letter from Professor Joseph Henry.

Princeton, N. J., Feb. 25th, 1842.

C. Evans, Esq:

Dear Sir:—I have deferred answering your letter relative to your Safety Apparatus until I could find time to make some experiments with the model you sent me, but I have been unable to give the subject any attention until within a few days past.

I have for the last few years been in the habit of mentioning to my class the advantages of using the fusible metal inclosed in a tube surrounded by the steam, for the purpose of setting off an "alarm" in case of the undue heating of the boiler, as proposed by my friend, Professor Bache; but I was not aware of the fact, until I was informed of it by Professor Bache himself, that you had independently applied the same principle to set in operation a self-acting apparatus for relieving the safety valve in case of danger.

I have made a number of experiments with your apparatus, the results of which are perfectly satisfactory. To determine if the discharge of the steam always takes place at the same pressure, the composition of the fusible metal remaining the same, I attached to the boiler a manometer gauge, and found that in each case the discharge took place at about a pressure of thirty-three pounds per square inch. The indications of the gauge did not vary from this more than a pound on either side in any of the experiments, although the quantity of water in the boilers was not precisely the same in all cases. I also have made some experiments on surcharged steam; for this purpose the water was suffered to get low in the boiler, and then the fire was removed from the bottom to the sides, so as to heat the metal above the water line, and surcharge the steam. Under these circumstances the fusible metal gave way at a pressure of about sixteen pounds.

These results appear so satisfactory, that I do not hesitate to state that I consider the plan of using the fusible metal, inclosed in a tube, exposed to the steam, and your arrangement for relieving the safety valve at the approach of danger, as the best contrivance which has been proposed to the public as a means of preventing the disastrous explosions from steam. With my best wishes for your success in introducing your invention into general use,

I remain respectfully yours, &c.,

Joseph Henry.

Observations on the effect of wind on the Suspension Bridge over the Menai Strait, more especially with reference to the injuries which its roadways sustained during the storm of January 1839. *By* W. A. Provis.

From the Proceedings of the Institution of Civil Engineers.

In the month of December, 1825, when the original construction of the bridge was nearly completed, several severe gales occurred, and

considerable motion was observed, both in the main chains and in the platform of the carriage ways. It appeared that the chains were not acted upon simultaneously, nor with equal intensity; it was believed, therefore, that if they were attached to each other, and retained in parallel plains, the total amount of movement would be diminished. On the 30th of January, and on the 6th of February, 1826, some heavy gales again caused considerable motion of the chains and roadway, breaking several of the vertical suspending rods, and of the iron bearers of the platform. These bearers were constructed of wrought iron bars, overlapping each other, and bolted together, with the ends of the suspending rods between them, for the purpose of giving stiffness to the structure. The flooring planks were bolted to the bearers, and notched to fit closely round the suspending rods, which were thereby held almost immovably in the platform. It was observed, that the character of the motion of the platform was not that of simple undulation, as had been anticipated, but the movement of the undulatory wave was oblique, both with respect to the lines of the bearers, and to the general direction of the bridge. It appeared that when the summit of the wave was at a given point on the windward side, it was not collateral with it on the leeward side, but, in relation to the flow of the wave, considerably behind it, and forming a diagonal line of wave across the platform. The tendency of this undulation was, therefore, to bend the bearers into a form produced by the oblique intersection of a vertical plane with the surface of the moving wave. The bearers were not calculated to resist a strain of this nature; they therefore were fractured, generally through the eyes on each side of the centre foot path, at the point of junction with the suspending rods, which being bent backwards and forwards where they were held fast at the surface of the roadway, were in many instances wrenched asunder also. The means adopted for repairing these injuries, and for preventing the recurrence of them, were, placing a stirrup, with a broad sole, beneath each of the fractured bearers, attaching it by an eye to the suspending rod, cutting away the planking for an inch around the rods, and at the same time bolting, transversely, to the underside of the roadway, an oak plank, fifteen feet long, between each two bearers, for the purpose of giving to the platform a greater degree of stiffness, combined with elasticity, than it previously possessed. The four lines of main chains were also connected by wrought iron bolts passing through the joint plates, placed horizontally between the chains. The effects of these alterations and transversely hollow, cast iron, distance pieces were so beneficial, that little or no injury occurred for nearly ten years. On the 23d of January, 1836, a more than usually severe gale caused violent undulation of the platform, and broke several rods. There can be little doubt that ten years' constant friction, combined with the shrinking of the timber, had relaxed the stiffness of the platform, and permitted an increased degree of undulation. The gate-keeper described the extreme amount of the rise and fall of the roadway in a heavy gale to be not less than sixteen feet; the greatest amount of motion being about half way between the pyramids and the centre of the bridge. In conse-

quence of the injuries sustained during this gale, the author and Mr. Rhodes were instructed to give in a report upon the state of the bridge, and on any repairs or additions which might appear desirable. The result of the examination was satisfactory; the whole of the masonry, the main chains, their attachments to the rock, the rollers and iron work upon the pyramids, and all the principal parts of the bridge, was as perfect as when first constructed; it was, however, recommended, "that a greater degree of rigidity should be given to the roadways, so that they should not bend so easily under vertical pressure." The bridge remained in the same state until the hurricane of the 6th and 7th of January, 1839; during the night of the 6th, all approach to the bridge was impracticable; the bridge-keeper, however, ascertained that the roadways were partially destroyed; and he in consequence traversed the strait in a boat in time to prevent the down mail from London driving on to the bridge. When the day broke, it was found that the centre foot path alone remained entire, while both the carriage ways were fractured in several places. The suspending rods appeared to have suffered the greatest amount of injury; out of the total number of 444, rather more than one-third were torn asunder; one piece, 175 feet long, of the north east carriage way, was hanging down and flapping in the wind; much of the parapet railing was blown away; the ties and distance pieces between the main chains were destroyed; the chains had resisted well, in spite of the violent oscillation they had been subjected to, to such an extent as to beat them together and strike the heads off bolts of three inches diameter. Means were immediately adopted for restoring the roadways; and so rapidly was this effected, that in five days carriages and horses passed over, while foot passengers were not at any time prevented from crossing. The opinion of Colonel Pasley, "that all the injuries which have occurred to the roadways of Suspension Bridges must have been caused by the violent action of the wind from below," is examined, and reasons given for the author's dissent from that opinion. The action of the wind upon the Conway and Hammersmith Bridges, is next examined; and from the amount of oscillation observed in all suspension bridges, the conclusion is arrived at, that winds act strongly and prejudicially on the fronts as well as on the horizontal surfaces of the platforms of suspension bridges, and that the effect of winds is modified and varied by the nature of the country, and the local circumstances connected with each individual bridge. Although differing in opinion from Colonel Pasley as to the general cause of injury to suspension bridges, the author agrees with him in the propriety of giving increased longitudinal rigidity to their platforms, to prevent or to restrict undulation. He advised its adoption in 1836, and applied his plan of stiffening by beams in 1839. He preferred beams to trussed framing, on account of the facility with which the former could be increased in number, to obtain any requisite degree of stiffness, and because he feared that trussed frames could not always be kept firmly in their true vertical positions.

Mr. Cowper was of opinion, that the real cause of injury to suspension bridges was the vibration of the chains and roadway. The

whole of the suspended part, when acted upon by the wind, became in some measure a pendulum; and if the gusts of wind were to recur at measured intervals, according either with the vibration of the pendulum, or with any multiples of it, such an amount of oscillation would ensue as must destroy the structure.—Mr. Brunel agreed with Mr. Cowper in his opinion of the cause of injury to bridges, and with the propriety of applying brace-chains, for preventing the vibration. He then alluded to the introduction of lateral braces in the bridge designed by Mr. Brunel, Sen., for the Isle of Bourbon. He had been at the Menai Bridge during a severe storm, and had particularly noticed the vibration of the chains, with the accompanying undulation of the platform. The force of the wind was not apparently from beneath; it appeared to act altogether laterally. The chains were too high above the roadway; their vibration commenced before the platform moved; the unequal lengths of the suspension rods then caused the undulating motion. His attention had latterly been much given to the subject, on account of the Clifton Suspension Bridge, now erecting under his direction. The span would be seven hundred feet, and the height above the water about two hundred feet. He intended to apply the system of brace chains at a small angle to check vibration. To two fixed points in the face of one pyramid would be attached two chains, each describing a curve horizontally beneath the platform, touching respectively the opposite sides of the centre of the bridge, and then extending to similar points on the other pyramid; there they were attached to two levers, the ends of which were connected with a counterbalance of about four tons weight applied to each; these weights would hold the chains sufficiently extended to enable them to resist the lateral action of the strongest winds, without their being so rigid as to endanger any part of the structure. By this contrivance, the platform would be kept firm, which was the chief point to be attained. In all suspension bridges the roadways had been made too flexible, and the slightest force was sufficient to cause vibration and undulation. The platform of the Clifton Bridge would have beneath it a complete system of trough-shaped triangular bracing, which would render it quite stiff. He was an advocate for bringing the main chains down to the platform, as at the Hammersmith bridge, and for attaching the bearers to the chains at two points only; when they were suspended by four rods, it not unfrequently happened, that the whole weight of a passing load was thrown upon the centre suspension rods, and the extremities of the bearers were lifted up and relieved from all pressure. The extent of the expansion and contraction of the chains was a point of importance. In the Menai Bridge, the main chains on a summer day would be as much as sixteen inches longer than in a winter's night. At the Clifton Bridge the difference under similar circumstances would be about twenty inches. The whole expansion of the back chain beyond the pyramids must be thrown into the suspended part. He would prefer having only one chain on each side of the bridge, and that chain much stronger than is usually adopted, but in deference to public opinion he had put two; he believed that they rarely expanded equally, and hence an unequal distribution of the weight of

the roadways upon the suspension rods occurred. A rigid platform would in some degree prevent this, but he had endeavoured to lessen the effects of unequal expansion by arranging a stirrup at the top of each suspending rod, so as to hold equally at all times upon both the chains, and thus cause each to sustain its proportion of the load.

Athenæum, May, 1841.

Description of a Coffre Dam used in Excavating Rock from the Navigable Channel of the River Ribble. By D. Stevenson.

The navigation of the Ribble being much impeded by natural bars or weirs of sandstone rock, compact gravel, or loose sand, several ineffectual attempts were made to remove these hindrances, and eventually Messrs. Stevenson and Sons (of Edinburgh) were consulted, and under their directions the present works were commenced. About half a mile below Preston, a bed of sandstone rock, upwards of 300 yards in length, stretches quite across the river; the higher parts are frequently left dry during the summer months. This natural weir exerts such an influence upon the flow of the tides, that neap tides which at twelve miles distance rise 14 feet, are not at all perceived at the quay at Preston. It was proposed to cut a channel through this bar, affording an average navigable depth of 20 feet at high water of spring tides. In some places, therefore, the excavation would be 13 feet six inches deep. After consideration it was determined to make use of a series of coffre dams, as the most effectual and economical mode of proceeding. Their construction may be thus briefly described:—A double row of wrought-iron bars, $2\frac{1}{2}$ inches in diameter, with *jumper* points worked upon them, were inserted vertically into the rock at regular intervals of 3 feet apart laterally, the second row being placed 3 feet behind the front row. When a sufficient number of bars were fixed, a tier of planking, 3 inches thick, with clasps to enable the planks to be fixed to the rods, was placed withinside. The lower edges of the planks were cut out roughly to the inequalities of the rock; they were then lowered, and by means of an iron rod, with a crooked end, those parts which did not touch the bottom were ascertained, and a change in the form made, until the plank rested its whole length on the rock: the lower edge was then beveled off, and being finally lowered to its place, the plank was beaten down by the force of a heavy mallet, upon an upright piece of wood resting upon the upper edge of the planks; the lower beveled edge yielding to the blows, sunk into the irregularities of the rock, and thus ultimately, in connexion with the puddle behind it, formed a perfectly water-tight joint. The lower planks being fixed, the upper ones were placed upon them; transverse tie bars were inserted at intervals; and the clay puddle was formed in the usual manner. In order that the navigation of the river should not be impeded, the diagonal stays were all placed inside the dams. These stays had joints at the upper ends, and being slipped over the tops of the iron rods, and kept in their places by cotters, their lower ends could be moved either horizontally or vertically, as the irregu-

larity of the rock required:—as the excavation proceeded, longer stays were easily substituted, by merely removing the cotter, sliding up the short stay, and replacing it by another suited to the increased depth. The sides of the dam were kept together by bars of iron connected to two horizontal wale pieces, 10 inches by 6 inches, placed on the outside of the vertical iron rods. When the dam was thus constructed, the water was pumped out by a steam engine of ten-horses power. The whole of the excavation, which was 300 yards in length, and 100 feet in width, was to be completed with three lengths of coffre dams, so contrived as to include within the second stretch the lower side of the first dam, in order to excavate the rock in which that row of piles was fixed. The first and second lengths have been executed; the third is now in progress, and the excavation is proceeding very rapidly. The sandstone rock does not require gunpowder. The total quantity to be excavated is estimated at 31,000 cubic yards. Some doubt existed in the mind of the engineer as to the security of the fastening of the iron rod piles by merely jumping them from 15 to 18 inches into the rock; they have, however, proved to be perfectly firm during heavy floods, when the whole dam has been submerged, and the velocity of the current which was rushing over it was not less than five miles per hour.

Ibid, July, 1841.

Canal Navigation.

Hitherto, the suspension of trade on all canals, when covered with ice of a very trifling thickness, was considered unavoidable; but it has now been satisfactorily established, by the plan adopted on the Forth and Clyde canal during the late storm, that the obstruction, so far from being insuperable, can be completely remedied. The canal Company, and the traders on the canal, are indebted for this improvement to the ingenuity and persevering exertions of Mr. Robert Wilson, one of the overseers, by whom the plan was proposed and carried into execution. The object was effected by means of strongly constructed ice-breakers. By the plan adopted during the late frost, the extraordinary sight of fleets of twenty vessels attached to ice-breakers, and drawn by sixty horses, was daily to be seen passing along the Forth and Clyde canal, through ice from six to ten inches in thickness, at the rate of two miles an hour; and the extent of the benefit conferred on the trade is illustrated by the fact, that, in many instances, vessels which were towed by the ice-breaker from Port Dundas to Grangemouth, made their voyages to London, Hull, and Newcastle, returned with a new cargo to Grangemouth, and were taken back, along the canal by the ice-breakers to Port Dundas, during the continuance of a single frost. The importance of this subject to all owners of, and traders on, canals is so great as to call for the utmost publicity, in order that the improvement may be generally adopted throughout the country.

Railway Magazine, April, 1841.

METEOROLOGICAL OBSERVATIONS FOR DECEMBER, 1841.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	18°	34°	30.25	30.30	W.	Moderate		Clear.	Clear.
	2	22	43	30.27	30.26	W.	do		Clear.	Cloudy.
	3	33	42	30.10	29.80	E.	do		Rain.	Rain.
	4	46	52	29.36	29.30	W.	Blust'ring	1.77	Cloudy.	Cloudy.
☽	5	36	36	29.30	29.30	W.	do		Cloudy.	Cloudy.
	6	33	40	29 50	29.56	W.	Moderate		Clear.	Cloudy.
	7	28	35	29.85	29.93	NW.	do		Clear.	Clear.
	8	24	40	30.10	30.10	W.	do		Clear.	Clear.
	9	39	49	29.90	29.80	SW.	do		Cloudy.	Cloudy.
	10	38	52	29.80	29.70	W. S.	do		Cloudy.	Rain.
	11	47	50	29.35	29.35	W.	do	.21	Cloudy.	Cloudy.
⊗	12	42	48	29.76	29.86	NW.	do		Clear.	Clear.
	13	31	47	30.10	29.98	NW.	Calm		Clear.	Cloudy.
	14	47	50	29.65	29.65	W.	Moderate		Rain.	Clear.
	15	38	52	29.90	29 90	SW.	do	.55	Clear.	Lightly cloudy.
	16	42	43	29.77	29.50	E.	Brisk		Rain.	Rain.
	17	34	32	29.40	29.40	NE.	do	1.10	Rain.	Snow.
	18	19	23	29.95	29.54	NW.	do	.55	Cloudy.	Partially cloudy.
	19	18	30	30.00	30.10	NW. W.	Moderate		Clear.	Cloudy.
☾	20	24	36	30.00	30.00	W. E.	do		Clear.	Lightly cloudy.
	21	26	30	29.95	29.95	E.	do		Cloudy.	Cloudy.
	22	13	20	30.55	30 55	E.	do		Clear.	Clear.
	23	22	32	30.45	30.25	NE.	do		Cloudy.	Rain.
	24	38	35	29.75	29.95	W.	do	1.80	Clear.	Clear.
	25	24	32	30.00	30.00	W. NE.	do		Cloudy.	Cloudy.
	26	18	30	30.10	30.05	SW.	do		Clear.	Clear.
	27	20	30	30.26	30.20	W.	do		Clear.	Clear.
☺	28	28	38	30 15	30.14	SE. S.	do		Snow.	Cloudy.
	29	30	40	30.25	30.27	NW.	do	.10	Por. Cloudy.	Clear.
	30	32	35	30.22	30.10	E. NW.	do		Cloudy.	Cloudy.
	31	29	38	30.10	29.96	W.	do		Par. Cloudy.	Cloudy.
		30.29	38.52	29.93	29.89			6.08		

Thermometer.
Maximum 52.00 on 4th, 10th, 15th. } Mean, 34.405.
Minimum 13.00 on 22nd.

Barometer.
Max. 30.55 on 22nd. } Mean 29.91
Min. 29.30 on 4th 5th.

JANUARY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	30°	40°	30.10	30.00	W.	Moderate		Clear.	Clear.
	2	33	49	29.70	29.50	W.	Brisk		Cloudy.	Hazy.
☽	3	17	22	29.94	30.00	W.	Moderate		Clear.	Clear.
	4	32	43	29.70	30.16	W.	Brisk		Cloudy.	Cloudy.
	5	22	30	30.16	30.26	W.	Calm		Clear.	Cloudy.
	6	19	34	30.40	30.25	E. SE.	do		Cloudy.	Cloudy.
	7	38	40	29.65	29.65	W.	do	.48	Rain.	Rain.
	8	30	37	30.00	30.15	E.	do		Cloudy.	Cloudy.
	9	36	47	29.95	30 00	W.	Moderate		Cloudy.	Clear.
	10	33	34	30.15	30.10	E.	do		Hazy.	Snow.
⊗	11	31	38	30.05	29.95	NE.	do	.33	Cloudy.	Snow.
	12	29	40	29.76	29.76	W.	do		Clear.	Clear.
	13	27	26	30.00	30.15	W.	do		Clear.	Clear.
	14	18	41	30.00	29.75	E. SW.	Brisk		Clear.	Cloudy.
	15	34	27	29.80	29.83	W.	do		Par. cloudy.	Par. cloudy.
	16	28	35	29.75	29.75	S.	Moderate		Cloudy.	Cloudy.
	17	31	42	30.00	29.95	SW.	Brisk		Cloudy.	Clear.
	18	30	50	29.95	30.00	SW.	Moderate		Clear.	Clear.
☾	19	32	51	29.95	29.90	SW. S.	do		Clear.	Clear.
	20	36	59	29.80	29.75	S.	do	.05	Fog.	Rain.
	21	43	42	29.40	29.40	W.	Brisk		Clear.	Flying clouds.
	22	30	33	29.80	29.80	W.	do		Flying cl'ds.	Flying clouds.
	23	18	23	30.30	30.35	NW.	Moderate		Clear.	Clear.
	24	13	24	30.50	30.50	NW.	do		Clear.	Clear.
	25	24	39	30.00	30.00	SW.	do		Cloudy.	Cloudy.
☺	36	28	45	29.80	29.70	SW.	do		Clear.	Lightly cloudy.
	27	36	36	30.05	29.95	W.	Blustery		Cloudy.	Clear.
	26	22	31	30.28	30.28	SW.	Brisk		Clear.	Clear.
	29	42	55	29.90	29.80	W. S.	Moderate		Cloudy.	Lightly cloudy.
	30	42	50	29.80	29.90	W.	Blustery		Clear.	Clear
	31	42	57	29.75	29.75	SW.	Moderate	.08	Cloudy.	Rain.
		29.87	39.42	29.95	29.94			0.94		

Thermometer.
Maximum 59.00 on 20th. } Mean 34.645.
Minimum 13.00 on 24th.

Barometer.
Maximum 30.50 on 24th. } Mean 29.945.
Minimum 29.40 on 21st.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

APRIL, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on the Internal Improvements of the Continent of Europe. *By* L. KLEIN, *Civil Engineer.*

[CONTINUED FROM PAGE 149.]

5. *Vienna and Raab Railroad.*

If the northern railroad is distinguished by its great extent, another railroad, beginning also at Vienna, and taking a southern direction, is remarkable for the grandeur of style in which it is executed. This is the Vienna and Raab railroad now opened and in operation to Neustadt, thirty miles, and in progress to Glocknitz, seventeen miles. As its name denotes, one direction to be taken by this railroad is to Raab in Hungary, and it is proposed to touch Presburg also, and to be continued from Raab to Buda, the capital of Hungary. Another project is the continuation of the line from Glocknitz, the present southern terminus, through Styria and Illiria to Trieste, the important Austrian sea port. Even if only one of these extensions should be carried into execution, this railroad must be regarded as one of the most gigantic undertakings on the continent.

The company of the Vienna and Raab railroad was formed in 1838; in April, 1839, the works were commenced on the section between Vienna and Neustadt; part of the latter was opened on the 16th of May, and the whole on the 20th of June, 1841. The line passes through a beautiful country, highly cultivated, and covered with small towns and villages, along the foot of the picturesque mountains, which

amphitheatrically surround the metropolis. The principal place on the line besides Neustadt, is the watering place of Baden, a favourite resort of the Viennese during the summer. Another interesting place on the line is Moedling, situated on the entrance of the beautiful valley called the "Bruhl," whose wild and romantic scenery attracts thousands from the city every Sunday.

With such attractions for the public, the company calculated on a million of passengers per year, and the results of their operations have thus far proved the correctness of this calculation. They resolved, in the anticipation of a considerable revenue, to construct their road on the most approved plans, to make the buildings and other structures on the line such, that they may serve to embellish the environs of the city, and to provide the road with the best engines and cars.

The Directors and Engineer seem, however, to have transgressed the limits which a prudent economy and due regard to the interest of the Stockholders should have prescribed them; but before I point out some of the errors, which have been committed, I shall try to give a short description of the road.

The principal depot, or station, is outside of the barriers of the city and its suburbs, and distant nearly two miles from the centre of the former; passing a considerable distance along the southern suburbs, it crosses the turnpikes which lead to Laxenburg, Italy, Hungary, &c., on viaducts, avoids the Vienna hill, and approaches the mountains, on the foot of which it continues in a southern direction to Baden and Neustadt. From Neustadt to Glocknitz the line goes nearly straight to the south-west. The maximum grade between Baden and Neustadt is 18.4 feet; between Vienna and Baden thirteen feet, and between Neustadt and Glocknitz 40.6 feet per mile. The smallest radius of curvature on the whole line is 6,222 feet (6,000 Vienna feet.)

Between Vienna and Neustadt the railroad has been graded for a double track; the width of the road bed is twenty-nine feet; the excavations were made fifty-six feet wide on the bottom, to leave ample room for ditches, which are three and a half feet deep. The slopes are one and a half to one, and on some places two to one. Several high embankments and deep cuts were required to give the proper level on the located line. The highest embankment is $46\frac{1}{2}$ feet, there are others of $41\frac{1}{2}$ feet, $40\frac{1}{2}$ feet, and thirty-two feet in height; the deepest cut is thirty-seven feet, partly in rock; 380,000 cubic yards of materials have been removed from this cut alone. The contents of excavations and embankments between Vienna and Neustadt is 4,500,000 cubic yards, and the average cost was seven cents per yard.

Of 136 road crossings, seventy-five are at the level of the railway, for the other sixty-one, bridges were constructed partly under and

partly over the railroad; amongst the latter is a lattice bridge of 125 feet span, the first one, I believe, executed in Germany. One hundred and twelve bridges and culverts were erected over streams and brooks, besides ninety small culverts of stone or wood for road crossings, &c. Many of the bridges are of large spans, or have oblique arches; at Baden there is a viaduct with forty-seven arches and 1431 feet in length.

A tunnel of 541 feet in length, twenty-nine feet wide, and twenty-five feet high, entirely arched with cut stones, belongs also to the interesting structures on the line. This tunnel has been built at an expense of 50,000 dollars, and is the first constructed in Austria. Having mentioned the principal works executed to bring the road bed to the proper level, I shall now briefly describe the superstructure:

Over the whole width of the road bed, in excavations as well as upon embankments, a layer of gravel, two feet thick, has been spread; cross-ties, twelve inches broad and four inches thick, were laid four feet apart, and longitudinal sills, nine inches broad and four inches high, fastened upon them with screw bolts; these sills serve as continuous supports to the iron H or ⊥ rail, weighing 52 lbs. per yard, which is kept fast by screws, the heads of which overlap the base of the rail. To effect a better contact, hair felt has been put between the base of the rails and the longitudinal sills. The ends of the rails, which are square, rest in flat chairs, weighing 12 lbs; the cross-ties and sills are of oak timber, and have cost thirty-five cents per cubic foot; the rails have cost 117 dollars per ton (2240 lbs.) delivered on the road, and the expense for the whole superstructure was 13,500 dollars per mile of single track. The railroad has a double track, and on account of the many stopping places, the sidings have besides a length of eight and a half miles. The width of track is four feet eight and a half inches.

The buildings erected on the Vienna and Raab railroad are both numerous and elegant. At the terminus at Vienna, the road is elevated seventeen feet above the natural surface of the ground, in order to let the turnpike roads pass under it; the passenger hall, where the passengers start and arrive, is therefore, in the second story of a large building, 385 feet long and ninety feet wide, covered with a free roof of this span. Below are the ticket offices, baggage room, &c., and two flights of stairs, one for the passengers who start, the other for those who arrive, lead to the waiting rooms and the cars. Near this building is the establishment for constructing and repairing locomotives and cars, surpassing in regard to its extent and machinery all others of this kind on any railroad. The whole establishment consisting of a large machine shop, a foundry, boiler shop, car houses, &c., occupies an area of 5000 square yards, and has cost 250,000 dollars.

Two high pressure engines, of twelve horse power each, serve to move the lathes, pump water, &c.; they were like the rest of the machinery imported from England. Last spring the following individuals were employed in this establishment: fifty-eight blacksmiths, eighty finishers, fifteen turners, twenty boiler makers, fourteen founders, sixty one joiners, ninety-nine carriage makers, twenty-six varnishers, thirty-five saddlers, and fifty-seven common laborers, in all 465 men. At the Vienna depot there is also a large building with three stories, serving at the same time as an hotel, and as a dwelling-house for the company's officers, a large watering station for the engines, &c.

Large depots are also at Neustadt, Baden and Moedling, and smaller ones on the numerous intermediate stopping places. At Baden the passenger halls are, like those at Vienna, upon an embankment in the middle of the long viaduct, above mentioned. There are also along the line twenty-eight houses for the men, constantly employed for watching and repairing the railroad, each of which contains a spacious lodging for a laborer with his family, and for some other men, when their assistance on the road should be required. There are in all on the railroad from Vienna to Neustadt, fourteen buildings with two or more stories, fifty-seven do. of one story, and forty-six viaduct stores.

The outfit consists at present in eighty-eight wheeled passenger cars of three different classes, built on the American model; some four-wheeled baggage cars and twenty locomotive engines. Of the latter, eleven are from England, three from Mr. Norris, in Philadelphia, and six were built in the company's own establishment, on the American principle.

The total cost of the railway from Vienna to Neustadt, including the machine shop, amounted to near 3,000,000 dollars, which is at the rate of 100,000 dollars per mile of road with a double track, with buildings, outfit, &c. The capital stock of the company is 6,250,000 dollars. The chief Engineer of the Vienna and Raab railroad is Mr. M. Shoenerer, under whose direction the Lintz and Gmunden, and the southern part of the Lintz and Budweis railroad have been constructed.

Whoever examines the above described railroad more carefully must become convinced, that far too much capital has been expended for objects not at all essential to the success of the undertaking; he finds, that by adopting more frequent changes in the grades, several heavy cuts and embankments could have been avoided; that there was no necessity at all for building a tunnel through a hill, which might have been entirely avoided by locating the line only a hundred yards farther east; that the superstructure is too strong and rigid, destruc-

tive to the cars and engines, and difficult to be kept in repair, on account of the timbers and rails being fastened together by screws; the strength of the rail is sufficient to do away with longitudinal bearing timbers, and a less costly superstructure would also have been the better one. The buildings are all very fine, one may say splendid, but the depots are not at all conveniently arranged for the accommodation of a great number of passengers. Had the buildings been made simpler, the depots, halls, &c., longer and wider, the money would certainly have been more judiciously applied. The eight wheeled cars are a good imitation of the American ones, as regards their appearance, size, arrangement of seats, &c.; but the trucks are badly constructed, the springs are too short, which, aided in part by the hardness of the road, makes the motion very uneasy. The introduction of engines of different manufactures is also no small mistake, which this company makes in common with so many others on the continent.

On the 16th of May, the line from Baden to Neustadt, about fifteen miles in length, was opened, and from that day up to the 28th of May, 1841, there traveled over the road,

	Passengers,	Income
	5,418	$1,202
A further section of road from Baden towards Vienna was put into operation on the 29th of May, and to the 19th day of June inclusive, were,	30,667	5,090
On the 20th of June, 1841, the whole line from Vienna to Neustadt was opened, and up to the 31st of July, 1841, there traveled	245,802	59,880
Total,	281,887	$ 66,172

It appears, therefore, that since the opening of the whole line, the average number of passengers per day has been 5,825, but on Sundays from 12,000 to 15,000 people generally traveled over the road. It may be estimated, that 180,000 passengers per month will use the road in summer, which for six months, would give already over one million. But we see at the same time, that the average receipt per passenger amounted only to 23½ cents,* and a million of passengers will therefore yield an income of only 235,000 dollars, which compared with the cost of construction, is short of eight per cent. Deduct one half as the expenses of operation, and there will remain only four per cent. as interest on the capital invested.

Such are the prospects of this railroad, which, if constructed with more economy, would have become the most productive in the mon-

* The passenger fare is one and three-fifths cent in the third class, two and one-third cents in the second, and three cents in the first class cars. The tickets for the different classes have different colours, corresponding to the colours of the cars.

archy. It is now dependent on a million of passengers per year, to yield a dividend of four, perhaps four and a half per cent. The stock is now sold at twenty-five per cent. below par, though the travel on the road exceeds all expectation.

Leaving out of sight the loss sustained by the Stockholders themselves, it must be regretted that the extravagant expenditure in the construction of this railroad, by its influence upon the comparative productiveness, will have a bad effect upon other undertakings of this kind, the accomplishment of which must in a considerable degree depend on the success of existing railroads.

6. *The first Hungarian Railroad, from Presburg to Tyrnau.*

The kingdom of Hungary, the largest province of the Austrian Empire, will also have its railroad communications. Several large projects are on foot, to extend this kind of improvements far into the interior of that vast country: that the Vienna and Raab railroad, above described, is intended to connect Vienna with Buda and Pest, has already been mentioned, as also, that a branch of the Emperor Ferdinand's northern road is to lead to Presburg, the seat of the Hungarian Diet. Of a much larger undertaking of a railroad through Hungary I shall have occasion to speak hereafter; the railroad I am now going to describe, is of minor importance, and more of a local interest, interesting however, as the first one brought into operation in Hungary. It extends from Presburg on the Danube to Tyrnau, passing some other small towns, and its total length is twenty-nine miles, of which one half is in operation, the other half in progress of construction.

The Presburg and Tyrnau railroad was projected as early as 1836, but the works were not commenced until late in 1839; the first section of the line, from Presburg to St. Georgen, was opened in September, 1840, and another section of five miles, to Boesing, at the end of June last. For this distance of fourteen miles the direction of the line is north-east, along the foot of the Carpathian mountains; it then takes a more easterly course to Tyrnau, where the road terminates.

There are many curves in the line, their smallest radius is 1500 feet; the road is undulating, and the maximum grade is thirty-five feet per mile. Total ascent from Presburg, 167 feet; descent, 119 feet. Line and profile have been chosen, to conform as much as possible to the natural surface of the ground, and to avoid large expenditure for grading and bridging. The superstructure is made according to the same views, that is, with regard to cheapness. Plate rails of two by seven-twelfths inches are fastened upon stringpieces of six by seven inches, which are keyed into cross-ties, formed of half-trees, twelve inches in diameter. The latter rest upon a bed of stones, with which material

all the spaces between the timbers are filled out to within three inches below the surface of the rails; the stones are then covered with a thin layer of gravel or sand, the road being worked by horse power. The track has the common width of four feet eight and a half inches.

The following are some of the average prices, so far as the road has been completed:

For excavating ground and forming embankments, per cubic yard measured only in excavations,	.07	cents.
For stone masonry in bridge abutments, per cubic yard,	$ 1.12	"
" brick masonry, " " "	1.50	"
" " " in arches, "	1.72	"

The cross-ties of oak cost forty-two cents a piece; the sills sixteen cents per running yard; the iron bars sixty-five dollars per ton; the laying down of track, including the formation of horse path, &c., has cost thirty-six cents per running yard of single track.

The expenditure for the part of the road already completed, amounted to 200,000 dollars, and the total cost of the whole line will not exceed 400,000 dollars, which is at the rate of only 13,800 dollars per mile, including buildings, outfit, &c. It is expected that about 100,000 passengers and 40,000 tons of freight (principally wood from the Carpathian mountains) will be transported annually over this railroad; it will therefore undoubtedly become a very profitable undertaking. Nevertheless, it was found very difficult to raise the funds necessary for the completion of the road, when the original capital of 250,000 dollars had been expended; so little confidence was put in the success of the undertaking, that the Directors had to appeal to the generosity, patriotism, and national pride of the Hungarians, to induce them to subscribe for the additional stock to the amount of 150,000 dollars. This stock was finally taken at the time when the shares had nearly no value at all in the market.

The following has been the traffic on the first nine miles of the road, from the opening of the same to the end of May, 1841:

		Income.
No. of passengers from Sept. 28, 1840, to April 30, 1841,	18,344	$ 1,581
" " in May, 1841,	6,788	577
Quantity of freight transported, 32,256 cwt.		575
		$ 2,733

The passenger fare was very low, viz:

			Per Mile.
For 9 miles from Presburg to St. Georgen,	1st class,	12.8 cts,	1.42 cts.
" " "	2d class,	8.0	0.89 "
" " "	3rd class,	6.4	0.71 "

Horse power is exclusively used upon this road; two horses generally take two cars, containing each twenty-four seats, and the distance of nine miles is performed in from fifty to sixty minutes. The whole line from Presburg to Tyrnau is expected to be finished early next year.

7. *Milan and Montza Railroad.*

This was the first railroad undertaken and executed in the Austrian dominions of Italy. The charter for it was granted on the 15th of November, 1839, and the work was executed early in 1840, so that on the 17th of August the line was put into operation. The total length of this road is only eight miles. From the 18th of August to the 31st of December, 1840, the number of passengers conveyed was 158,218, and the income 25,943 dollars.

8. *The Lombardo-Venetian Ferdinand's Road,*

From Venice to Milan, now in progress, was chartered on the 4th of April, 1840, and will have a length of 180 miles. It extends from Venice through the cities of Padua, Vicenza, Verona, Brescia, and Bergam to Milan; the section from Venice to Mestre has been first let, and the greatest work of this, and perhaps of any railroad hitherto executed on the continent, is the bridge over the Lagunes at Venice, which will have 252 arches and a length of 11,870 feet. This bridge was let on the 30th of July, 1840, for 805,000 dollars, for which sum it has to be built so as to serve also for the proposed aqueduct. Should the latter not be required, the stipulated sum is only 750,000 dollars. The cost of the whole railroad is estimated at 9,650,000 dollars, which is equal to 53,611 dollars per mile.

Railroads Projected, but not yet Commenced.

Several important projects for railroads in different provinces of the Austrian Empire have been undertaken in the last two years, with more or less prospect of an early accomplishment. The rumors of war, created last year by the critical state of the Oriental affairs, the stagnation of business, and the distrust in the success of those railroads which have been finished, have much retarded the progress of internal improvements, by preventing capitalists from embarking their money in similar undertakings. As yet, the government has not given any direct aid to railroads by taking stock, lending its credit, or guaranteeing a minimum interest to the Stockholders, as has been done in other parts of Europe. Such an assistance would serve to give a new impulse to enterprise, and insure an early execution to many interesting projects. The following are the railroads projected:

1. *The Bohemian Coal Railroad,* from Pilsen to Budweis in Bohemia, the object of which is the cheap transportation of coal from the rich mines near Pilsen to Budweis, and over the Budweis and Lintz

railroad to the Danube and to Vienna. The total length of this road, for which the surveys and plans have been finished, is 108 miles. Maximum grade, sixty feet per mile; smallest radius of curvature, 1200 feet. Country very broken, and unfavorable for the construction of a railroad. Estimated cost, about 4,000,000 dollars.

2. *The Prague and Dresden Railroad* is intended to connect the capital of Bohemia with that of Saxony, and has been recently projected. It is to unite at Dresden with the Leipsic and Dresden, and at Prague with the Vienna and Prague railroad, which latter will probably be executed by the company of the Emperor Ferdinand's northern road. The country is very hilly and mountainous, and the road confined to the narrow valley of the Moldun and the Elbe. Probable length, 122 miles; the surveys are now making.

3. *The Vienna and Trieste Railroad* is a gigantic project; in its proposed direction from Neustadt (to where the Vienna and Raab railroad extends) through Styria and Illiria, over Gratz and Laibach, it would have a length of 375 miles. There are four principal summits between Vienna and Trieste, on two of which horse power will have to be used. The maximum grade for the remainder of the road is fifty-five feet per mile. Nothing has yet been done towards the execution of this work.

4. *The Central Railroad of Hungary* commences at Presburg and goes along the left bank of the Danube to Pest, from thence in an easterly direction to Debretzin. Total length of main line 330 miles. The surveys for this railroad are made, and a company has been formed with a capital of 4,000,000 dollars, on which five per cent. have been called in. The works have not yet been commenced.

5. *The Railroad from Bochnia to Lemberg* is designed as a continuation of the Emperor Ferdinand's northern road, which terminates at Bochnia to Lemberg, the capital of Galicia, from whence it is ultimately to be continued to Brody, on the frontier of Russia. Distance from Bochnia to Lemberg, 190 miles. The surveys for this road have been recently commenced.

The total length of railroads now in operation in the Austrian Empire is 350 miles, of which 172 miles are worked by horses, and 178 miles by Locomotive engines. There are at present besides 175 miles of railroads under construction, and the total length of all railroads completed and in progress in Austria, is 840 miles; while the aggregate lengths of those railroads, which have been projected, but not yet commenced, is 1,125 miles. The total amount of capital already expended in the Austrian Empire for railroads will be about fourteen millions of dollars.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the use of Piles for Railway Superstructures. *By* John C. Trautwine, *C. E.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Since the appearance in the January number of your Journal of my paper on the cast iron rail,* which I contemplate adopting on the Hiwassee railroad, I have received a letter from an esteemed professional friend, for whose opinion I entertain the highest regard, cautioning me in the strongest terms against the use of piles for my superstructure. He assures me that experience, so far as it goes, is entirely against them; and that their adoption on my road, would inevitably be injurious to my professional character.

In support of his opinion, he adds that every Engineer with whom he has conversed on the subject, coincides with him; and I am myself aware that a very general prejudice exists among the profession, not only in the United States, but in England, against employing piles in a railway superstructure. It is therefore with some hesitation that I venture to advance a contrary doctrine against so formidable an array of the fraternity; but after a close and careful investigation of the subject in all its bearings, I feel constrained so to do; having arrived at the conviction, not only that the grounds of prejudice against piles are entirely insufficient to justify their rejection, but that on the contrary, they may, by proper management, be made to furnish a road far less liable to derangement, either *vertically* or *horizontally,* than any of the plans now in common use; and moreover, that they will, where so employed, effect a diminution in the annual expenditures of many of our railroads, of at least 25 per cent.

This conclusion I have arrived at, after carefully comparing the piled superstructure with all the plans in general use, many of which have to a greater or less extent been constructed under my own immediate superintendence, thus affording me a fair opportunity of testing their several defects and advantages, and of instituting a comparison of their respective merits and demerits.

* I will here take occasion to correct two or three errors and omissions which I see have occurred (from the manuscript) in the above mentioned paper. On page twenty-four, four lines from the bottom, instead of " and more than six times as great as would be required to break it," read " and that one six times as great would be required to break it." Also, on second line from bottom, instead of " fifteen tons" for the test load of the rail, read " ten tons." This same error recurs at page twenty-six, six lines from the bottom. There is also an omission of reference to fig. *c* in the engraving.

Fig. *c*, represents the centre of the rail, showing the projecting flanges for confining the centre of the rail from longitudinal motion, so as to compel all contraction and expansion, by changes of temperature, to take place from the centre towards each end.

I would earnestly invite such of my readers as are sceptical on the subject, to defer coming to a final decision, until they have resorted to the same process for satisfying their doubts. I suspect that any impartial person who will take this trouble, will acquiesce in the opinions which I advanced in the paper alluded to, viz. that piles will before long supersede all other foundations for railroad superstructures.

Nothing can on reflection be more evident, than that no branch of constructive engineering, of equal importance, is so radically defective, as that of placing the superstructure of a railroad, which essentially requires the adjunct of the most unyielding support, upon almost the very *surface* of the earth, which is, of all foundations the most treacherous.

Instead of presenting a perfectly firm and incompressible basis for the rails, this, in wet weather, actually becomes, to a depth of several inches, so far as regards consistency, and resistance, either *vertically* or *horizontally*, but little better than a bed of mortar, or a layer of quicksand.

Let the reader who needs confirmation of this assertion, watch the progress of a train of loaded cars, over almost any of our railroads, after a few days of rain; when he sees the undulations that take place as the supports are alternately subjected to, and relieved from, the pressure of the engine and cars as they pass, he will more readily coincide with my views, and his only source of surprise will probably be, that the annual expenses for the adjustment of the track, are not more serious than they are. A calculation, which may serve for a moment's amusement, will show that every heavy rain creates an expenditure on a railroad 100 miles in length, of from $1,000 to $3,000.

Were the ground never wet, a railroad superstructure of common construction would answer its purpose admirably; either vertical or horizontal derangement would be almost impossible, and the road would retain its adjustments for years. Every Engineer is, I presume, acquainted with the almost entire resistance to wear, presented by perfectly dry earth; and knows that the most durable turnpike would be made, by merely sheltering from the weather the space it was intended to occupy, without any necessity for a stone covering.

But such an exemption from the action of water is not to be attained in either turnpike or railroad practice; and we are obliged to employ the best methods we can devise for resisting the encroachments of this insidious and powerful enemy.

That this has hitherto been effected, to the extent desirable in practice, no Engineer will assert; on the contrary, the inefficacy of all the plans hitherto resorted to for the purpose, is a source of great and

very serious annual expenditure on every railroad that has been constructed; in some cases absorbing so heavy a proportion of the income, as completely to destroy the character of the road, as an object of pecuniary investment.

The expenses for labour and materials for retaining the adjustments of superstructure, amount, on such of our wooden railroads as are doing a tolerable business, *to an average of about one-half the entire annual expenses of the concern.* It is true, we frequently see this item set down in the reports of Directors and Engineers, at much less than the above proportion; but when this is done, it is generally with reference to *new* roads, on which time for derangements of the track has not yet been allowed. On roads that have come fairly into operation, and are accommodating a good traffic, the above average assumption is tolerably correct, and applies as well to the flat bar road with light engines and moderate velocities, as to the most durable edge-rail road with its heavy engines, moving at high speed. It is scarcely necessary to suggest to any professional reader, the difficulty of attempting to assume *average* proportions in cases like the foregoing. They serve well enough the purposes of the general reader. The Engineer will take them at their worth.

When we reflect that this most serious item of railroad expenditure, is produced by the action of rain and frost, how solicitous should we be to adopt the necessary precautions, to obviate the effects of these agents, so far as lies in our power.

We cannot prevent the occurrence of either rain or frost; but we can place our foundations at a depth to which the action of neither can reach; and, at the surface, where their effects are most powerful, we can oppose to them such materials, and so arranged, as to render their attacks comparatively harmless.

It is common to employ trenches, some fifteen to twenty-four inches in depth, and filled with broken stone, under the immediate supports of our superstructures, whether of wood and iron, or of stone and iron. These trenches perform at least one good office, viz: the drainage of surface water, which would otherwise expedite the decay of the timbers; and to a considerable extent, they diminish the effects of the frost. They are, however, too shallow to remedy the evil resulting from the softening of the earth by rain, which percolating through the broken stone, collects in the bottom of the trench, and reduces the soil to a consistency affording very little *vertical* resistance to the pressure of passing loads, as the undulations after heavy rains fully prove.

It is moreover equally obvious, that the softened earth or mud at the *surface*, is not at all calculated to withstand the horizontal pressure of the trains; especially as they sweep rapidly around the curves, or

lurch violently from side to side on deranged portions of the straight lines. It has, I suspect, come within the observation of most of my professional readers, that on tolerably sudden curves the mere elasticity of the rail, or sometimes of the wooden string timbers, tending to restore themselves to their original straightness, not unfrequently exerts sufficient lateral pressure to overcome the resistance of the earth, and force the superstructure outwards, until it becomes, instead of a continuous curve, a mere series of chords.

I am by no means confident that even trenches filled with *solid concrete*, as now proposed by some, and which appear to meet with pretty general approbation with the profession, will be found entirely to remedy these defects; unless the trenches are deeper than those now commonly used in superstructures. If this precaution be attended to, the percolation of water, and consequently the action of frost, will be to a great degree prevented. But other difficulties suggest themselves in connexion with the use of concrete in this manner, which to me appear insuperable. For instance, the ground under these continuous lines of concrete cannot be expected to be of uniform consistency; and we know that high embankments do not reach their period of final settlement for several years; consequently, the concrete will, in many cases, act the part of a long stone girder, supported only at its ends; and again, it frequently happens that isolated rocks present themselves in the graded surface, which will prevent the centre of a given length of concrete from settling equally with the adjoining parts. Either of these occurrences will inevitably produce fractures, such as frequently occurred in the continuous granite sills of yore. I remarked above, that these difficulties appeared to me insuperable; I should have said, except at an expense that few railroad companies could afford to encounter. I should have no confidence in concrete formed of *common* lime only, for this purpose; and if hydraulic cement be used, the cost of continuous trenches of sufficient size would be enormous.

When we look at the plan of stone-block and edge-rail superstructure, there is even less to commend itself on the score of stability than in the wooden railroads. This is the plan of the Liverpool and Manchester road, and of some roads in the United States, on which the expenses of repairs and adjustments of track are very heavy. This item, of course, must increase with the traffic of the road, but it is also dependent to an equal degree, upon the weight and velocity of the engines. The engines now in common use are certainly too heavy for the superstructures of many of the railroads on which they run, and under such circumstances their introduction is adverse to every principle of true economy.

I confess, that when I first began to consider what could be done by

means of piles, to remedy the defects attending the ordinary methods of superstructure, they seemed to present more formidable obstacles than almost any other plan; and the apparent magnitude of their objectionable features was no doubt augmented by the prejudice which I had entertained against them. But upon reflection, these prejudices vanished. The ordinary plans of superstructure are liable to derangement *both vertically and horizontally;* no one will deny that piles are at least free from the former objection. We have then, in the ordinary plans, *two* movements to guard against; in the piled superstructure we have but *one.*

Nearly all the examples of piled roads in the United States, are either those in which the piles are left extending several feet above ground, as a substitute for embankment, and thus affording a great leverage for the lateral action of trains to operate through, to produce horizontal displacement; or, in other instances, they are driven through a soft superstructure of marsh, quicksand, &c., that their feet may rest on a firm subsoil. This latter case evidently resolves itself to all practical intents and purposes into the former; for the yielding surface stratum affords nearly as free a leverage for producing lateral motion, as if the upper part of the pile were in the air.

Other roads again, have short piles driven their entire length into firm soil; but here they are generally but about three feet in length, and intended as an economical substitute for stone blocks, and are plainly liable to the same derangements as they from rain and frost.

Lastly, piles are sometimes used not as *supports,* but as *stays.* They were, I believe, first employed in this manner by Mr. Brunel, on the Great Western railroad in England; nor do I know that the example has been subsequently imitated on any other roads. Mr. Brunel has placed them in the centre of the track, and the cross-ties are bolted *to their sides.* They are intended only as stays against lateral motion.*

Although somewhat irrelevant to the subject, I will here remark, that this plan of construction appears to me to be essentially defective. Unless the rail-timbers be rendered *absolutely free* from vertical motion, (and this I contend cannot be effected by any plan now in use) a very injurious strain must come upon the cross-ties, which will even-

* Mr. Brunel had another object in view, which constitutes the chief peculiarity of his pile plan of superstructure for the Great Western railway. It was, by employing the retaining power of the piles, to enable him to force sand or gravel beneath the continuous bearings of timber until they cambered, or received *an upward pressure* of about a ton per foot lineal; and Mr. Brunel expected, that the force thus made to act *upwards* against the underside of the continuous bearings, would countervail the pressure *downwards,* produced by the passing trains. (See 3rd English Ed. (1838) Wood on Railroads, p. 718.) Com. Pub.

tually uphold, as it were, the entire superstructure by means of their bolts, for at their ends, they inevitably *must* yield; while at their centre, they quite as certainly *cannot* do so. This defect might readily be obviated by making the bolt hole elliptical, the longer axis being vertical. A vertical motion could thus be allowed, which would not at all interfere with the lateral resistance of the piles.

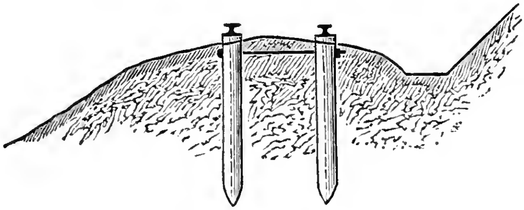
Here are, I believe, all the plans with which I am acquainted, in which piles have been employed in railroad superstructures; and it is, I suspect, entirely upon the self-evident inefficiency of any of these methods to combine vertical and horizontal stability, that the use of piles has been so universally denounced.

In the course of my own professional studies, I have invariably been more benefited by investigating instances of *failure*, than those of *success;* and it has been chiefly from the failures of piles in all the above cases, to fulfil their intended offices, that I have drawn my conclusions as to their entire efficiency, when so employed as to obviate the objections thus practically pointed out.

One very important collateral advantage resulting from the attainment of perfect stability in the superstructure, will be a diminution in the weight of the rail, which is one of the heaviest items of expense on railroads. The entire freedom from sudden shocks, and from the constant succession of *percussions,* which occur on all railroads of ordinary construction, will not only allow of such a diminution in the weight of rail, but will add greatly to the comfort of passengers, and prevent the injury which experience shows to result to many important articles of traffic, as flour, &c., from the jolting motion on a badly adjusted railroad. This stability will also remove the greatest impediment to the introduction of cast-iron rails; a matter in which not only railroad companies, but American iron masters, are deeply interested.

In employing piles as I propose, making them the principal source of immobility in railroad superstructures, two cases present themselves, requiring, or rather admitting of, some variation in the mode of operation. The first case, (which embraces the Hiwassee railroad) is that of a road in a warm climate, where the frost rarely penetrates to a greater depth than from three to six inches; and where the soil, being of a firm gravelly nature, enables us, by curving the road transversely, to confine the softening influence of even long continued rains, also, to a depth of a few inches. I am surprised at the want of attention to this method of drainage, every where observable on our railroads. It is one of the most simple, most perfect, and least expensive of any that can be adopted. Perhaps one half the water that now percolates through the broken stone to the bottom of the trenches could be thus got rid of.

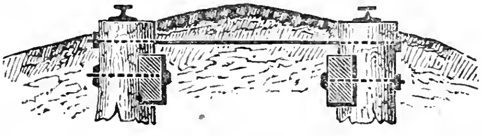
In this case, I suspect, that piles from ten to fifteen inches in diameter, and averaging from six to ten feet in length, placed at intervals of from three to four feet apart from centre to centre, and driven down until their tops are but two or three inches above the surface, and connected transversely either by iron tie-rods, or by wooden cross-ties, would be found to answer every purpose. See figure.



Engineers are so apt to connect the idea of piles, with that of a soft, yielding foundation, that it is difficult to divest themselves of the association. The very term, pile, seems necessarily to involve lateral weakness; but in this case it is not so. Our piles are not supposed to be driven into a marshy soil, but into earth so compact as actually to require holes to be dug previously, through the upper consolidated stratum to a depth of two or three feet, to give them admission, for without this precaution, their driving would prove to be a troublesome business. But when firmly driven, and the soil well compacted around them by heavy rollers, the case more nearly resembles that of the stump of a tree, unyielding in any direction; and admits of no comparison with the instability of a common superstructure, with its base well lubricated with wet unctuous clay.

But let us, for the sake of argument, admit that some additional precautions *should* be found necessary in this instance; how easy would it be to apply it to any required extent, by simply bolting to the piles stout longitudinal pieces as shown in this sketch—*a*.

a



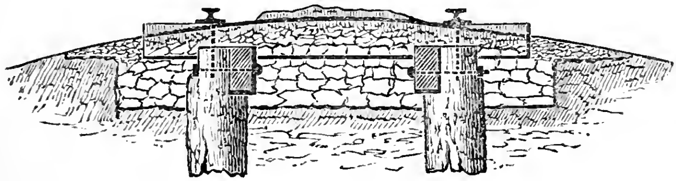
I do not know that it is a matter of much importance on which side of the piles the longitudinal pieces be bolted. We will now take leave of *case No.* 1, merely cautioning the reader once more, to divest himself of all notions of marsh-mud; and to substitute in his mind's eye, a firm, *dry* soil, almost incompressible by any force that can be applied to it. If necessary, a stratum of well rammed McAdam stone might be used to a depth of three or four inches, to facilitate the dis-

charge of rain water from between the rails. Should such a superstructure, in such a climate, and on such a soil, not be found infinitely more unyielding, both vertically and horizontally, than those on the ordinary plans, then will I of a truth exclaim, "peccavi," I have sinned.

Let us now pass on to *case No.* 2; by which I mean nothing more nor less than a railroad in a severe northern climate, where the rain and frost combined, produce a sensible deranging action on superstructures to the depth of about two feet.

Here, there is manifestly no more difficulty in securing the *feet* of the piles, or in other words, in attaining *vertical* stability, than in *case No* 1; the only essential point of difference is to provide for the heads of the piles, a stratum which shall at all times be (practically considered) perfectly dry, and incompressible; and on which the upward action of frost at the bottom of the stratum, shall be comparatively harmless.

b



This desideratum I propose to effect by the very plain process indicated by figure *b*, which represents a transverse section of a continuous trench, about eighteen inches deep and nine feet wide, filled with broken stone, to form the stratum alluded to. At the bottom of the trench, the stone might consist of tolerably large sized spalls; but a thin layer at top should be of McAdam size, to throw off rain as much as possible. After the piles are driven, and the longitudinal pieces bolted on by screw-bolts, the first layer of stone should be put in, and well rolled by a horse-roller; then the cross-ties put on, and the remainder of the stone introduced and finished off by ramming, to conform to the curved line, nearly covering the cross-ties.

My impression is, that the diminished action of the frost at this depth, will loose itself, as it were, among the broken stone; and that the stratum will at all times remain so compact as effectually to prevent lateral motion.

Of course, I do not wish to be understood as confining myself to the above forms of construction in the timber work; it may be modified according to the judgment of the Engineer. I think it probable that a mere covering of McAdam stone well compacted and properly attend-

ed to at intervals, would be found sufficient to keep the *natural* upper stratum dry, and if so, it would be attended by some saving of expense. Neither gravel nor sand would in my opinion answer as a substitute for broken stone for filling the trenches. The former would admit of compression from the roundness of its particles; and the latter, by becoming saturated with rain.

All I desire is to establish the supremacy of a piled superstructure over others hitherto employed. If my poor efforts in its behalf, accomplish nothing more than to induce the profession maturely to weigh its claims to a preference, I shall have accomplished my principal object in writing this paper; for I feel convinced that their so doing, will lead to its adoption. I particularly insist on the curved surface, and every other available means to effect *a thorough surface drainage.* This is all essential to *every* plan of railroad superstructure; and it is only surprising that so little attention has been paid to it. The ramming process should be repeated, whenever experience shall indicate a necessity for it; probably at every fall and spring, will be sufficient.

Should the heads and feet of the piles be found to bruise in driving, (as they certainly would without proper precautions to prevent it,) the former may, according to Major Turnbull, of the United States Topographical Engineers, (see his very valuable report on the Potomac aqueduct,) be obviated by simply dressing off the head of the pile to a concavity of about an inch, and adapting to it a piece of sheet iron; and the latter by nailing on a narrow strip of the same material.

On the score of expense, piles will be found to compare not very unfavorably with other plans of superstructure. To form a good and economical road, the timber should by all means be either Kyanized, or Earle-ized.* Probably, the latter process will be most extensively employed in future, as it is much the cheapest.

I have before asserted, that if the piled superstructure should succeed, (and I certainly see no reason to doubt that it will) it will effect a diminution of the annual expenses, and a consequent increase of annual profits, of at least twenty-five per cent. Before closing this paper, it may not be amiss to consider on what grounds my assertion is based.

In doing this, I will again admonish my professional reader of the

* Doubts have recently arisen with regard to the efficacy of Earle's process for the preservation of timber. These doubts are chiefly founded upon two facts:

I. The wooden pavement in this city, in Sixth street between Chesnut and George, a part of which was prepared by Earle's process prior to being laid, *now exhibits symptoms of decay.*

II. The recent admirable experiments of M. Boucherie, upon the means of preserving timber, show that whilst corrosive sublimate, and pyrolignite of iron, effectually protected vegetable pulps from decay; the sulphates of copper and iron, (employed by Dr. Earle) were so inert as to retard corruption in but a very trifling degree. Com. Pub.

difficulty one labours under in attempting to *average,* and *generalize* in these matters. If my assumptions should appear to some of them to be too low, and to others too high, let them exercise a little charity towards me; for I am fully sensible of the vagueness of deductions drawn from such premises.

Let us then assume the gross annual expenses of maintaining a single track railroad, doing a tolerable business, at $1,000 per mile per annum. One half of this, or $500 per mile per annum, may, in most instances, be assigned to labour, materials and tools, necessary for repairs and adjustments of the track; $300 of it to labour, and $200 to materials and tools.

Now on the supposition that our timber is Kyanized, we may safely count upon reducing the former item to $150, and the latter to $100, which gives an annual saving of expense of $250 per mile, which is twenty-five per cent on our assumed total expenses of $1,000. And if, moreover, we set down the annual expenses at one half the gross annual receipts, which on the average is not very far from the truth, we of course have, instead of an annual profit of $1,000 per mile, one of $1,250, or an increase of twenty-five per cent.

Certainly this is an object worth striving after, and one affecting seriously the success of the railroad system. Whether it can be secured by the adoption of a piled superstructure of Kyanized timber, must be left for experience to determine. I think it can, and I hold moreover to the belief, that the attainment of a *perfect (practical) railroad,* will be found essentially to depend upon the aid of piles.

Improvement of the Ohio River.

We are indebted to the politeness of C. B. Trego, Esq., of the House of Representatives of this state, for a copy of the report "Relative to the navigation of the Ohio River" made to the Senate, by a select committee, of which Mr. Darsie, of Alleghany, was Chairman.

From this document we extract two statistical tables, prepared by Mr. Josiah King, a merchant of Pittsburg, (at the request of the chairman of the select committee,) which are valuable, as furnishing a proximate view of the present export trade of that city, and the existing charges of transportation thence, by the Ohio river, in its present condition.

The report referred to, is designed to attract the attention of the Federal Government, to the importance of scouring away the shoals of the Ohio by *wing-dams,* so as to form a steamboat navigation, having at the lowest stages of the water a minimum depth of four feet from Pittsburg, in this state, to the falls in the river at Louisville, Kentucky, a distance of 609 miles. COM. PUB.

Table showing the amount of tonnage shipped at Pittsburg to ports on the Ohio river, from 15th July to 15th November, inclusive, in the years 1840–'41, at the various rates per 100 lbs. actually paid; the aggregate cost, the average cost per 100 lbs., the cost of the same at 25 cents per 100 lbs., and the excess aggregate sum paid over 25 cents per 100 lbs. Compiled chiefly from shippers' books, by J. King.

TABLE No. 1.

	Quantity of freight shipped at Pittsburg, at the following rates per 100 lbs., from the 15th of July to the 15th of November, 1840 and 1841.										Aggregate lbs. ship'd in 4 low water months 1840 & 1841.
	$1 75	$1 50	$1 25	$1 00	87½ cts.	75 cts.	62½ cts.	50 cts.	40 cts.	25 cts.	Total lbs.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1840,	240,000	228,000	912,000	2,040,000	144,000	3,876,000	2,946,000	1,290,000	1,146,000	1,332,000	14,154,000
1841,	150,000	1,104,000	1,920,000	3,792,000	696,000	1,944,000	1,260,000	1,506,000	60,000	330,000	12,762,000
Total,	390,000	1,332,000	2,832,000	5,832,000	840,000	5,820,000	4,206,000	2,796,000	1,206,000	1,662,000	26,916,000

	Aggregate lbs. ship'd in 4 low water months, 1840 & 1841.	Aggregate cost of same.	Average cost per 100 lbs.	Aggregate cost computed at 25 cts. per 100 lbs.	Excess of actual cost over 25 cts. per 100 lbs.
	Total lbs.				
1840,	14,154,000	$102,626 50	72½ cts.	$35,385 00	$67,241 00
1841,	12,762,000	118,245 00	92½ "	31,905 00	86,340 00
Total,	26,916,000	$220,871 50		$67,290 00	$153,581 00

There were from 15th July to 15th November, 1841, departures of steamboats from Pittsburg, for ports on the Ohio river, 115.

Estimated number cabin passengers, at $5 each above average high water rates, 5,750,	$28,750 00
Estimated number steerage passengers, at $2 each above average high water rates, 8,000,	16,000 00
There were, in same time, departures of Keels and Barges, 187, with 2,000 passengers, at $1 extra,	2,000 00
Add to this the extra amount on freights, as above, in 1841,	86,340 00
And we have an excess on the business of the port of Pittsburg alone, in one year, of	$133,090 00

You will observe that the above table contemplates only the business of Pittsburg. I have no data for estimating the business that pertains to the various other ports on the Ohio, but it is in all probability, altogether, four times as much as what is here exhibited. It should be borne in mind also, that if a permanent depth of three feet could be secured on the Ohio river, a vast amount of business would be done that is forced into other more lengthy and hazardous routes. It is now a matter of complaint by the Philadelphia merchants, that they were compelled, during the past summer, to pay 25 to $30,000 freight from Philadelphia to New York, on goods sold to their customers, who, from the low water in the Ohio, were forced to the longer and more expensive route of the Lakes.

Another important consideration in favor of improving the Ohio river is, that not only Pennsylvania, but Maryland, Ohio, and New York, have expended millions in constructing canals and railways with reference to the trade of this river, and almost every state in the Union has a deep interest in it as a link of much moment in their chain of commercial intercourse. There are about 400 steamboats on the western rivers, and at least 100 of those belong properly to the Ohio river trade; more than that number indeed were built and are owned at Pittsburg.

The following table is compiled from the records of the City Wharf Master.

TABLE No. 2.

1841.	Steamboat Arrivals,	Tonnage at Custom-House Measurement,	Keel Boat Departures,	Tonnage computed,	Depth of Channel, at 1st and 15th of month.		Flat—Depart,	Tonnage,
					1st. Feet, Inches,	15th. Feet, Inches,		
January,	23	3,440	12	260	Ice.	11.0		
February,	28	2,982	11	213	9.6	Ice.		
March,	93	12,235	27	623	4.6	6.0		
April,	94	12,908	48	1,013	15.0	9.4		
May,	86	12,463	49	1,090	12.3	10.0		
June,	66	7,514	50	1,100	4.6	2.5		
July,	34	3,732	49	1,485	4.4	1.11		
August,	8	319	57	2,115	1.9	0.11		
September,	13	1,028	60	2,460	1.3	1.0		
October,	47	3,521	44	1,510	2.10	2.6		
November,	69	8,539	43	1,100	2.10	4.0		
December,	59	8,047	24	530	5.2	11.0		
Total,	620	76,728	474	13,499			1,218	9,206
	653	79,850	Departures S. Boats.					
Total,	1,273	156,578	Arrivals and Departures.					

Note by J. King.—The steamboats arriving up the river from July to October may be said, generally, to carry no cargo. They take very little down, but run chiefly with reference to passengers, and for what freight they do take at stages of water below three feet high, rates say 75 to 150 per c. 100 wt. to Louisville, is charged. Boats of draft and bearings adapted to a thirty inch stage of water are multiplying; and if the river could be so improved as never to have less than thirty inches in channel, individual enterprise would immediately furnish boats in numbers adequate to carry any amount of freight that might offer, (it is confidently believed,) at 25 c. per 100 wt. and thereby if prices of freight be reduced to a proper standard on the Pennsylvania canals, render the Ohio river and Pennsylvania route, the *cheapest*, as it is the shortest and safest between most of the western states and the sea-board. The foregoing table is interesting, not as exhibiting a *large* business done, but as showing that a considerable business found its way via. Pittsburg, to the Ohio river, despite exorbitant rates both on the canals and river, amounting to $3 per 100 wt., from Philadelphia, or Baltimore, to Louisville; and thus demonstrating, that if the expense of the same service can be permanently reduced to $1 or $1½, the route in question would be the favorite route, and all the while filled with goods and produce in transitu between the eastern and western cities. It is the opinion of experienced navigators of the Ohio river, that wooden steamboats can and will be constructed to carry eighty or 100 tons of cargo, on thirty inches of water, and that iron boats can be made to carry 100 to 150, on the same water.

Rules and regulations, proposed to be observed by Enginemen, Guards, Policemen, and others, on all Railways, recommended by the Railway Conference held at Birmingham, England, Jan. 1841.

Orders to Enginemen and Firemen.

I.—No locomotive steam engine, except in case of some extraordinary necessity, shall pass along the wrong line of road—that is to say, on the right hand line as it moves forward—but shall, in all cases, observe the same rule of the way as on the turnpike roads, by proceeding along the left-hand line. And every engineman and fireman shall keep a good look-out all the time the engine is in motion. And no person, except the proper engineman and fireman shall be allowed to ride on any locomotive steam engine or tender without the special license of the Directors, or of the engineer or manager of the railway.

II.—In case of accident, if any engine shall be unavoidably obliged to pass on the wrong line of road, the engineman shall always send his assistant, or some other person, back beyond the nearest stopping place, or shunt, before the engine moves backward, to warn any engine coming in the opposite direction; and if dark, the man who goes back in advance of a returning engine shall take a light, and make a signal, by waving the same UP and DOWN to any coming engine to stop; and the engineman of the engine moving on the wrong line shall make constant use of the steam-whistle, and must not move in the wrong direction further than to the nearest shunt, and being arrived there, shall proceed instantly to remove the engine off the wrong line of road.

III.—All engines traveling in the same direction shall keep half a mile at least apart from each other; that is to say, the engine which follows shall not approach within half a mile of the engine which goes before.

IV.—No engineman shall, at any time or under any circumstances, leave his engine or train, or any part of his train, on the line of way, without placing a man in charge of the same, to cause the proper signals to be made to prevent other engines from running against them.

V.—Enginemen having charge of goods or luggage trains shall always exert themselves to keep out of the way of coach trains, by shunting, if necessary; and, if doubtful of getting out of the way of a coach train, shall direct gatemen and plate-layers to make signal to coach trains that a luggage train is before them.

VI.—No engine, carriage, or wagon, or train of carriages or wagons, whether loaded or unloaded, shall (except only in case of absolute necessity, to prevent accident or collision) stop upon the line of any highway, so as to interrupt the passing along such highway or public road, whether the same be at, or near, to any of the stopping places on the railway or not.

VII.—No engine shall be allowed to propel before it a train of carriages or wagons, but shall in all cases draw the same after it, except when assisting up an inclined plane, or in case of any engine being disabled on the road, when the succeeding engine may propel the train

slowly as far as the next shunt, or turn-out, at which place the said propelling engine shall take the lead.

VIII.—In the event of the road being obscured by steam or smoke, (owing to a burst tube, or from any other cause,) any engine or train coming up shall not immediately pass through the steam or smoke, but the engineman shall stop at a sufficient distance to prevent a collision, and shall ascertain that the way is clear and safe before attempting to proceed.

IX.—If a coach train be stopping to take up or set down passengers, on the road, or for any other cause, luggage trains are not allowed to pass it, while so stopping, on the opposite line; and if the engineman of a *coach train* sees another coach train stopping on the road, he must slacken speed as he approaches it, and blow his whistle, to give notice to passengers belonging to the stopping train, that another train is about to pass them.

X.—In going down any inclined plane, every engineman having charge of a luggage train shall take care that he has full and complete control over the speed of his train, by pinning down, or causing to be pinned down, his wagon breaks, fewer or more, according to the size or weight of the train, whether there be a luggage breaksman with the train or not. And in case of accident for want of this proper control over the speed, the engineman shall be held responsible. And the policemen at the top of the inclines shall, and are hereby charged to, assist in pinning down the breaks, when desired so to do by the engineman of the train.

Rules to be observed during a Fog, or in Thick Weather.

XI.—Whenever a coach train stops at any of the stations or places for taking up or setting down passengers, (during a fog, or in thick weather,) the gateman or policeman of the station shall immediately run 400 yards behind the train, or so far as may be necessary to warn any coming engine, in order to prevent its running against the other; and all enginemen shall slacken speed in foggy weather, and proceed at a slow pace at an ample distance from, and as they approach, each of the stations and stopping places, in order that they may have the complete control of and be able to stop their engines and trains without risk of running against any train which may happen to be waiting at such station or stopping place. And in case any engine (whether with coaches or luggage wagons, or without) shall stop in foggy or thick weather in any part of the road where there shall be no platelayer to render assistance, the fireman shall immediately run back 400 yards, or so far as may be necessary to warn and stop any other engine coming in the same direction.

In foggy weather, enginemen are cautioned to make frequent use of their steam-whistle when they approach any station; also, whenever they are obliged to stop on the road, or when, from any cause, they are obliged to go slower than usual, in order to prevent accidents from trains which may be following on the same line.

Order to Gatemen and Policemen.

XII.—All policemen and gatemen are required, when a luggage train approaches their several stations, and before she comes up, to go on the line and inspect both sides of the train, to ascertain whether any of the loading (particularly bags of cotton or wool) have slipped so as to *overhang* the wagon more than when first loaded; and if such be the case, to make immediate signal for the *train to stop*, in order that the loading may be put right and fastened on again before the train proceeds.

N. B.—All enginemen, firemen, guards, policemen, gatemen and others to whom the foregoing rules may apply, are held responsible for their strict execution and observance; and they shall report to the Directors, or to their immediate superintendent, any servant of the Company who shall refuse or neglect to comply with the regulations hereby ordered to be observed.

Code of Signals recommended to be observed on all Railways.

By Night.—The *white* light, stationary, indicates that all is right, but if waved *up* and *down*, is a signal to stop; if waved *to* and *fro*, sideways, to proceed cautiously.

The *Red* light, stationary, is a signal *always to stop;* if on a moving train it is a caution to all following trains to keep the required distance.

By day.—The *Red* flag, or ball disc, is the signal always to stop.

The *Blue* flag, or ball, is to stop second class coach trains or luggage trains, for the purposes of traffic.

The *Black* flag is used by plate-layers, to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood, that any flag, or hat, or lamp, of whatever colour, waved up or down, is a signal to *stop*.

Regulations as to Signals.—1. Every train on the railway shall shew a red bull's eye, or reflector lamp, on the last carriage or wagon; and the guards of the coach trains, the breaksman of the luggage trains, and the engineman of an empty engine, or, with a wagon train without a breaksman, shall see to, and be held responsible for, the execution of this order; and if a coach, or truck, or horse-box, or wagon, be attached to, or detached from, a train on any part of the road, the guard, or breaksman, or engineman shall immediately change and replace the red bull's eye, or reflector lamp, so that the same may still be in the *rear* of the last carriage or wagon in the train, showing backward.

2.—Every engine tender must carry a lamp, so fixed as to admit of being turned round, exhibiting a *white* light forward, and a *red* light backward, in whichever direction the engine may be moving.

3.—Every gateman or policeman shall light his gate or station lamp at dusk, and shall have his hand lamp constantly trimmed and burning, and ready to give such signals as may be required.

4.—If a coming engine or train be required to stop to take up passengers, a *blue* light must be shewn in the gate-lamp; otherwise the common *white* light.

5.—If a train approaches when a previous train has passed through, only a few minutes before, the gateman shall signify this circumstance to the engineman by the waving of his hand-lamp *to* and *fro*, sideways, which means that caution is required; on which signal all enginemen are required to go slowly and keep a good look out.

6.—But if a gateman, owing to some accident, or any extraordinary cause, wish to stop an engine which is approaching, he must show his *red* light, and must also wave his hand-lamp *up* and *down*, up to the height of his head, and then down to the ground, till the engine comes up; and all enginemen are required to stop at either of these signals being given; and a gateman must make this signal to an approaching engine, if a previous engine has passed through his gate only one or two minutes before.

N. B.—The *red* flag, or ball, must be used in the day, in the same manner as the *red* lamp by night.

Rockets or *blue* lights are extraordinary signals, and when an engineman sees them he must immediately stop to ascertain their cause.

Engine Whistle.—7. When *one long whistle* is given, it is a signal to gate-keepers, policemen, and others in front, that an engine is coming, and this signal is to be used on approaching public roads. during a fog, or when a first class train approaches a station where a second class train is stopping, and generally as a caution when required, for persons on the line to keep out of the way.

But when an engineman wishes to make signal to the guards, or breaksmen, *on the train* that they are to put on their breaks and stop, he must give a *quick succession of whistles*, making an interrupted, tremulous, or vibrating sound; and all guards, or breaksmen, whether with coach or luggage trains, hearing this signal, *must immediately* hold hard on the break, or breaks, under their charge, so as to stop the train *as quickly as possible.*

Locomotive Engines on the English Railways.

It is doubtless known to most of our readers that on the railways of Great Britain, the Locomotive engines in use, may chiefly be separated into two distinct classes.

I. The *four-wheeled* engines, of the pattern manufactured by E. Bury, of Liverpool, and perhaps by others.

II. The *six-wheeled* engines, devised by R. Stephenson, and manufactured by various parties.

The first kind of engine has four wheels, coupled or uncoupled; when used to draw freight its wheels are coupled, but when employed as a passenger engine, the coupling bars (if it has them) are taken off, and but two wheels are then used as drivers.

These engines are commonly allowed only from one half to one inch play at both flanges, and have other peculiarities not necessary to be enumerated for our present purpose.

The second kind of engine has six wheels upon *a stiff frame*—the play allowed to the flanges is from one to two inches—the middle pair of wheels are usually, if not invariably, the drivers, and have no flanges: though we notice in the drawings of engines of this pattern, made by the Messrs. Rennie, and by the Messrs. Hawthorn, that flanges are shown to all the wheels.

There are, we believe, some locomotive engines of other forms used in England,—but they are comparatively few,—and for general purposes we may regard the English locomotives as admitting of the classification adopted.

We believe it has been a prevalent opinion in England that the six-wheeled engines—on account of their stiff frames, great length, and large flange play—were more apt to "fly the track" in consequence of lateral irregularities or curves in the road, than those with only four wheels; yet some serious accidents have occured with the latter, especially one on the London and Brighton railway, in October, 1841, where a four-wheeled engine, attached in front of one with six-wheels, was employed to aid it with a heavy train; and whilst the two machines were advancing with their load, at a pace of nearly thirty miles an hour, they entered an irregular piece of road, when the auxiliary, or four-wheeled engine, which was leading the van, suddenly commenced lurching, and upset from the track, causing the loss of several lives.

The coroner's jury who examined into the circumstances of this case, levied a small deodand upon the locomotives, and pronounced the opinion in their verdict, "that the four-wheeled engines used on this line, are not of a safe construction, and they recommend their discontinuance."

This verdict at once roused public attention to the subject, the condemnation of four-wheeled engines being directly in the face of the experience upon the London and Birmingham railway, where more than *ninety* similar machines of Bury's pattern were in use, and had conveyed some hundreds of thousands of passengers with great speed and perfect safety.

The press immediately engaged in the discussion of the relative merits of four and six-wheeled locomotive engines, and as might have been anticipated, diametrically opposite opinions were advanced—with equal plausibility and force on both sides—without reaching satisfactory conclusions.

Under these circumstances, Mr. Herapath, the editor of the Railway Magazine, undertook a special tour over the most important railways, by actually riding upon the locomotives with the engine drivers; proposing to note carefully the motions and peculiarities of the two species of engines, and collect a mass of practical facts, which would en-

able a sound and safe opinion to be formed upon this question, so important in English railway practice: the results of this tour have been communicated to the Railway Magazine, in a series of articles which we propose to republish for the information of our readers, though we must remark, that the working of the English machines does not have as direct an application to American locomotives as might be imagined, in consequence of the present almost universal use in this country of six-wheeled engines, *with leading and vibrating trucks,* which entirely and most favorably change the running character of the machine, from that inherent to the stiff framed six-wheeled engines employed upon the English railroads; the leading truck piloting the locomotive through curved and irregular portions of the way with a facility and success, which enables them to travel safely upon sinuous roads—even though curved with radii as low as 400 feet—with a speed, that if practicable at all, would certainly not be safe, with the six-wheels fixed upon a stiff frame, as in the English locomotive engines.

M.

From the Railway Magazine.

Facts and Observations on Four and Six-Wheel Engines. By JOHN HERAPATH, ESQ.

North Union.—The Company belonging to this line (from Parkside, on the Liverpool and Manchester railway to Preston, 22½ miles,) work with their engines the Preston and Wyre, nineteen miles, and Lancaster and Preston, twenty-one miles, and yet, strange to say, farm the carriage of their own goods upon their own line. They have twenty-three passenger engines, namely, two six-wheel engines and twenty-one four-wheel. Their six-wheel have outside bearings, and their four-wheel all inside. The six-wheel are about 12½ tons each, having four and a half tons on the front wheels, seven on the driving, and one ton on the hind wheels. Their mode of working these engines is somewhat peculiar. An engine runs one day 174 miles, the next 129, and the third day eighty-four, after which it rests for examination and reparation, if wanted, three days. They have no coupled engines, and their average gross load is about fifty tons, including engine and tender, and all their driving-wheels have flanges. The number of efficient engines is now twenty, which, compared with some other lines, speaks volumes in praise of the care and good management of their locomotive superintendent, Mr. Hunt, whom I found to be not only exceedingly polite and attentive, but a very observing and intelligent young man.

"We have only," says this gentleman, in the official reply to my circular, "had one broken cranked axle, broken in the cheek of the crank, and the engine was not able to proceed after the fracture. The engine—a six-wheel uncoupled engine—having outside bearings, was, I believe, the principal cause of the fracture, which happened in a curve descending sixteen feet a mile." No accident or inconvenience,

save delay, happened in consequence. Nor has any engine run off the rails.

Mr. Hunt speaks in very warm terms of Bury's engines, several of which are on the line.

The play of the wheels upon the rails of this line varies from three-fourths to seven-eighths of an inch. The cost of a four-wheel engine is £1,150; and of a six, £1,250. They find the four-wheel engines more economical in repairs, and burn a trifle less of coke. For instance, two six-wheel in the last year, including, it is said, some rather unusual repairs, cost £524; while seventeen four-wheel, for the same period, cost, altogether, £1,836; and the average consumption of coke per mile, by the four-wheel, is 35.42 lbs.; and of the six-wheel, 35.54 lbs. There is a trifling rolling motion in both four and six-wheel engines, when descending or upon curves, but Mr. Hunt thinks the six-wheel rather the steadier of the two. They have no engines which can be called top-heavy. In reply to the question whether they have any practical proof that the distance of the cranks from the longitudinal axis produces any sinuous motion, Mr. H. says, they have in an outside cylinder engine. He adds, from his experience on the Dublin and Kingstown railway, that the longer the connecting rod, and the wider the application of power is, the greater is the effect of sinuous motion. On the Dublin and Kingstown it seems there are outside bearings, and cylinders outside of these.

The total number of miles run per annum by all the engines of this company is 253,596, and the average of each engine, 13,347, the expense per mile of the locomotive power being 1s. 6.7d., including a sum for depreciation, which I could not ascertain exactly, but believe amounts to about the odd pence over the shilling.

Upon two of this company's engines I rode—namely, No. 13, a six-wheel engine, and No. 1, a four-wheel with outside cylinders, and four feet six inches wheels. The motion of the former engine I did not find to be at all different from that of other six-wheel engines; but the outside cylinder engine had some of that wriggling motion I observed in the American engines, but not so much as in Norris's. I must confess, however, notwithstanding I have found the same motions in all three engines I have ridden on having outside cylinders, that I am still unconvinced that it is exclusively due to the outside cylinders; but of this hereafter.

Manchester and Leeds Railway.—Before I say anything of the object of my visit to this line, I must be permitted to render my public acknowledgments for the generous and handsome conduct I have experienced from beginning to end from the Directors, officers, and all parties without exception, belonging to this company with whom I have come in contact. Captain Laws, the manager, has been particularly anxious to afford me every opportunity and facility for prosecuting my inquiries, and to him and Mr. Fenton, the superintendent of the locomotives, I am indebted for much valuable information.

I have indeed had the good fortune on this line to have made such observations, and to have such facts brought before me, as to enable

me to decide on one or two points, on which, before, I had great difficulty in making up my mind, and I therefore consider myself peculiarly fortunate in my intercourse with the Manchester and Leeds railway.

The length of the line worked by this company is sixty miles from Manchester to Leeds, but the portion constructed by them is only fifty-one miles, that is, from Manchester to Normantown, the junction with the North Midland railway. The company's stock of engines is thirty-eight, that is thirty-six six-wheel with outside bearings, and two four-wheel with inside bearings. Of these thirty-three are now in an efficient state. The six-wheel engines weigh in working trim about seventeen tons; the four-wheel thirteen tons, twelve cwt.; the weight on the front wheels of the six-wheel engines is six tons, on the driving eight and a half, and on the hind wheels two and a half. On the driving-wheels of the four-wheel engines the weight is about eight and a half tons.

Of the six-wheel engines eighteen have coupled wheels, and both the four-wheels are coupled.

Many of the driving wheels of the six-wheel—indeed, nearly all that I have seen—are without flanges, but others have them. The average gross load is 104 tons.

Owing to the heavy gradients on this line, particularly from Manchester to the summit, the engines are necessarily weighty. Of fourteen engines which began running July, 1839, only one crank axle, however, has broken; and of eighteen which began February, 1841, only two crank axles have broken; one from a flaw in the iron, and the other not. One was a coupled engine, and the other two uncoupled. They were unable to proceed with their trains, but no injury happened to any passenger in consequence. Notwithstanding, there are some sharp curves in this line, for instance, three respectively of fifteen, twenty, and thirty chains radius, and that the average speed is high, no engine has at any time run off the rails. The average pressure worked with is fifty-five lbs. to the square inch, the cost of the engines £1,500, the consumption of coke thirty-seven lbs. per mile, number of miles run per year by all the engines 594,000, expense of repairs 2s. 6d. per mile run.

The engines of this company generally run 120 miles each day, (changing, however, their times, so as to equalise the work of each) for five days successively, and then resting two days for examination and repairs. Each engine carries a sand-box to obviate the greasiness of the rails, which their heavy loads, and the almost everlasting dampness of the Manchester atmosphere render quite necessary.

The returns to me on this line are far more full than I have yet received from any other company. It appears that there are 147 men and boys, with wages varying from £2 6s. 8d. to boys 7s. 4d. per week, employed in the locomotive department only, making an average of £1 8s. 11d. per week; that the cost of coke for six months, ending August 31st last, was £3,786 7s. 6d., the wages on repairs done £977 1s. 10d., the cost of repairs not done by the company £1,643 1s. 5d.; the average speed in miles per hour actually performed by passen-

ger trains is twenty, the number of stoppages, exclusive of termini, being equal to 11½ miles per trip; the average weight of passenger trains, exclusive of engine and tender, fifty tons; and of goods trains, with the same exclusion, 104 tons; the average coke consumed per mile traveled, with passenger trains, is 35.52 lbs.; with goods, 48.02 lbs.; the average cost of repairs per mile traveled by the engines, is 2.62d.; cost of coke per mile, 3.09d.; cost of other charges, not included in repairs, 4.92d. per mile; and the total cost per mile of the passenger trains 10.12d. and of luggage 11.94d.; the weekly miles run for passenger trains are 7,140, for goods 2,732, and pilot engines 993. The length of the line is sixty miles, number of stations when the 147 men are employed is seven.

Mr. Fenton assured me that no engine comes in from the maker without undergoing most extensive alterations. The system of working expansively, and discharging the steam before the end of the stroke, it seems, has found its way long since into this establishment, together with other improvements in the chimney, fire-box, &c., which I shall hereafter notice, by which great savings accrue to the company in the working of the line. Captain Laws, indeed, in the general management, appears to be well seconded by the ability and untiring zeal of Mr. Fenton, in the locomotive department.

I have already alluded to the kind attentions I have received from the officers of this company—one, not among the least gratifying to me, was the putting on of a four-wheel engine, the "Clarence," with the coupling rod off, to take a train of goods as far as Rochdale, 10½ miles, and return with another load, that I might satisfy myself of any peculiarities of its action up and down steep gradients as a four-wheel engine. This was one of Bury's engines, and a play of 1.2 inch upon the rails. When in high speed she had a good deal of sinuous motion, but was free from pitching or rolling. At starting I observed her lift in front, so as to give me some alarm. This I found was occasioned by the road being sanded, which gave the wheels a good bite on the rails, the coupling link being some six inches above the axles of the wheels, and the steam being let on too rapidly.

While standing Friday morning, November 26th, on the platform with Mr. Gill, Captain Laws, and Mr. Fenton, an engine, the "Dewsbury," a six-wheel-engine, came in with a load which she had brought all the way from Todmorden, a distance of nineteen miles, wholly disabled in the left cylinder, and having drawn her load with the right only. A part of the road was up hill, but the greater portion down hill. When she came in I observed the left leading wheel much cut in the flange, and pointed it out to Captain Laws as an effect of the sharp curves on the line, which he, however, would not admit. Reflecting upon this, and after the engine had backed about 200 yards, a thought struck me that it might be owing to the action of one cylinder. I consequently hastened to her, and found that she had also her left trailing wheel flange a trifle cut (her driving wheels having no flanges,) but neither of the wheel flanges on the right side of her, it was evident, had approached the rails at all, or gone near them. With these facts I was much pleased, as affording practically conclusive evi-

dence on a disputed point, to which, in my report, I shall probably recur.

By some accident, I had not the good fortune to meet with Mr. Gooch, the company's engineer, who I understand is a very talented and well informed man.

The improvements which I have alluded to in the locomotives in this establishment are—

1st—An improvement in the chimney. As the makers deliver the engine it is cylindrical, fourteen inches diameter. The improvement consists in turning into the frustum of a cone, the upper part being thirteen inches diameter and the lower only ten. By this contrivance alone Mr. Fenton informed me that four cwt. of coke was saved on thirty-seven cwt. in a run of 120 miles, the blast pipe being opened from three to three and three-fourth inches in diameter.

2ndly—Various trials having convinced him that about sixteen inches was the best depth for the fuel of the fire when the bars were horizontal, but that in all cases of horizontal bars the coke near the door was in a less intense combustion than near the tube plate, he gave the bars an inclination of one in ten descending towards the tube plate, and placed the level of the bars near the door of the fire-box, 13½ inches below the lowest tube, which made the inner part of the bars 17½ inches below the said lowest tube, the fire-box being forty inches in length.

3rdly—For the purpose of taking away the damper from the chimney, he made the ash-box nearly air-tight all round except in front. By this means he stopped the further combustion of the coke, and lowered his steam at pleasure.

By the means of these improvements, and cutting off at five-sixths of the stroke and suffering the steam to escape, he successively improved the engines as they come from the maker. The following two are examples:—

Name.	As from Maker.	Improved July.	Further improved, Aug.	Do. do. Sep.
"Mersey,"	59.05lbs.	not running	32.27	27.27
"Irk,"	52.88	25.45	25.65	24.80

Upon the four-wheel engines of this company the weight on the driving wheels in a working trim is seven tons twelve cwt.; on the leading wheels six tons, cost £1,450; cost of the six-wheel engines, about £100 each more.

This company possess upon the whole an excellent stock of powerful engines, kept in a most efficient state of repair, and those on which I have rode are inferior in steadiness of motion to none that I have met with. I believe they reckon the engines of Sharp, Roberts, & Co. among their best.

Grand Junction.—I forgot in my account of the Grand Junction to mention that their gross average load is about fifty-eight tons; that some of their engines have only five feet driving wheels, though most are five feet six inches; that each engine runs about 195 miles the day of its work; that they have one four-wheel engine (which I understand is a pattern engine for the Paris and Rouen railway) built with

outside cylinders, and I believe five feet driving-wheels; and that the number of miles run daily by the engines, is 1588, including nineteen extra miles each journey between Manchester and Warrington.

I was exceedingly desirous of riding on the new four-wheel outside cylinder engine, for the purpose of seeing whether this engine had the same shuffling, wriggling motion that three others of the kind had on which I had rode. So anxious was I on this account that one very cold day I went without my breakfast to keep an appointment made with me to put the engine on, but was for some reason disappointed; the engine, which I believe was not at all on the list to go out, having been put on at a very different hour.

[TO BE CONTINUED.]

Practical and Theoretical Mechanics and Chemistry.

Analysis of Well-water, Philadelphia. *By* Jas. C. Booth and M. H. Boye.

Induced to undertake the examination of this water by Mr. Samuel Webb, of Philadelphia, we deemed it a matter of sufficient interest to extend our investigations farther than required, in order to ascertain with precision all its constituents, and therefore, we think that it may not be uninteresting to some of the readers of the Journal.

The well is in the yard of 158 West Callowhill street, and was made by first digging about twenty feet through the common superficial clays, and then several feet into the Gneiss rock in a partially decomposed state. Although water was obtained in the clay, it was yielded much more abundantly after penetrating the rock, so that the water from the latter is the prevailing character of the fluid in question.

A sediment sometimes appears in it, but at the time we obtained it, it was said to be unusually clear. It was this clear water which we subjected to analysis. It exhibits a slight acid reaction, and deposites by standing at first a red flocculent precipitate of hydrated peroxide of iron, and subsequently coats the vessel containing it with an adherent layer of an ochrey color, consisting chiefly of the above oxide of iron with the carbonates of lime and magnesia. The same sediment was obtained more abundantly by evaporating the water into a small bulk and subsequent filtration. The sediment and the concentrated liquid evaporated to dryness, were separately investigated.

The deposite consists in 100 parts of:

Silica,	27.75
Peroxide of Iron,	4.83
Carbonate of Lime,	45.15
" Magnesia,	22.27
	100.00

The concentrated liquid, evaporated to dryness, gave a residue of the following composition:

Silica, - - - - - -	10.91
Peroxide of Iron, - -	a trace
Carbonate of Lime, - - -	4.09
" Magnesia, - -	3.40
" Soda, - - -	34.65
Chloride of Sodium, - - -	44.74
" Potassium, - -	2.21
	100.00

The whole amount of solid matter in one gallon of the water was 6.22 grains, of which about eight-fifteenths, or a little more than one half, was deposited during evaporation. In this should be included a small amount of sulphuric acid, and a mere trace of organic matter which were neglected in the analysis.

Observations on Mosaic Work and Cameo-cutting. *By* Ch. H. Wilson, Esq., *Architect, Edinburgh.*

The art of mosaic work has been known in Rome since the days of the republic. The severe rulers of that period forbade the introduction of foreign marbles, and the republican mosaics are all in black and white. Under the empire the art was greatly improved, and not merely by the introduction of marbles of various colours, but by the invention of artificial stones, termed by the Italians *smalti,* which can be made of every variety of tint.

This art was never entirely lost. On the introduction of pictures into Christian temples, they were first made of mosaic; remaining specimens of these are rude, but profoundly interesting in a historical point of view. When art was restored in Italy, mosaic also was improved, but it attained its greatest perfection in the last and present century. Roman mosaic, as now practised, may be described as being the production of pictures by connecting together numerous minute pieces of coloured marble or artificial stones; these are attached to a ground of copper by means of a strong cement of gum mastic, and other materials, and are afterwards ground and polished as a stone would be to a perfectly level surface; by this art not only are ornaments made on a small scale, but pictures of the largest size are copied. In former times the largest cupolas of churches, and not unfrequently the entire walls, were encrusted with mosaic. The most remarkable modern works are the copies which have been executed of some of the most important works of the great masters for the altars in St. Peter's. These are in every respect perfect imitations of the originals; and when the originals, in spite of every care, must change and perish, these mosaics will still convey to distant ages a perfect idea of the triumphs of art achieved in the fifteenth century. The government

manufactory in Rome occupies the apartments in the Vatican which were used as offices of the Inquisition. No copies are now made, but cases of *smalti* are shewn, containing, it is said, 18,000 different tints. Twenty years were employed in making one of the copies I have mentioned. The pieces of mosaic vary in size from an eighth to a sixteenth of an inch, and eleven men were employed for that time on each picture.

A great improvement was introduced into the art in 1775 by the Signor Raffaelli, who thought of preparing the *smalti* in what may be termed fine threads. The pastes or *smalti* are manufactured at Venice in the shape of crayons, or like sticks of sealing-wax, and are afterwards drawn out by the workman at a blow-pipe into the thickness he requires, often almost to a hair, and now seldom thicker than the finest grass stalk. For tables and large articles, of course, the pieces are thicker; but the beauty of the workmanship, the soft gradation of the tints, and the cost, depend upon the minuteness of the pieces, and the skill displayed by the artist. A ruin, a group of flowers or figures, will employ a good artist about two months when only two inches square, and a specimen of such a description costs from L.5 to L.20, according to the execution; a landscape, six inches by four, would require eighteen months, and would cost from forty to fifty pounds. This will strike you as no adequate remuneration for the time bestowed. The finest ornaments for a lady, consisting of necklace, ear-rings, and brooch, cost L.40. For a picture of Paestum, eight feet long, and twenty inches broad, on which four men were occupied for three years, L.1000 Sterling was asked.

The Mosaic Work of Florence,

I shall now notice before touching on cameo-cutting. It differs entirely from Roman mosaic, being composed of stones inserted in comparatively large masses; it is called work in *pietra dura*. The stones used are all, more or less, of a rare and precious nature. In old specimens the most beautiful works are those in which the designs are of an arabesque character. The most remarkable specimen of this description of pietra dura is an octagonal table in the *Gabinetto di Baroccio*, in the Florence Gallery. It is valued at £20,000 Sterling, and was commenced in 1623 by Jacopo Datelli, from designs by Ligozzi. Twenty-two artists worked upon it without interruption till it was terminated in the year 1649. Attempts at landscapes, and the imitation of natural objects, were usually failures in former times,—mere works of labour, which did not attain their object; but of late works have been produced in this art, in which are represented groups of flowers and fruit, vases, musical instruments, and other compatible objects, with a truth and beauty which excite the utmost admiration and surprise. These pictures in stone are, however, enormously expensive, and can only be seen in the palaces of the great. Two tables in the Palazzo Pitti are valued at £7000, and this price is by no means excessive. These are of modern design, on a ground of porphyry, and ten men were employed for four years on one of them, and a spot is pointed out, not more than three inches square, on which a man had

worked for ten months. But Florentine mosaic, like that of Rome, is not merely used for cabinet tables or other ornamental articles; the walls of the spacious chapel which is used as the burial-place of the reigning family at Florence are lined with pietra dura, realizing the gem-encrusted halls of the Arabian tales. Roman mosaic, as we have seen, is of great value as an ally to art; but Florentine mosaic can have no such pretensions, and time and money might be better bestowed.

An imitation of the pietra dura is now made to a great extent in Derbyshire, where the Duke of Devonshire's black marble, said to be quite equal to the famous Nero Antico, is inlaid with malachite, Derbyshire spars, and other stones; but the inlaying is only by veneers, and not done in the solid as at Florence. This, with the softness of the materials, makes the Derbyshire work much cheaper, and yet for a table, twenty to twenty-four inches in diameter, thirty guineas is asked. Were a little more taste in design and skill in execution shewn, the Derbyshire work might deserve to be more valued, as the materials, especially the black marble, are beautiful.

I shall now return to cameo-cutting. The art of cameo-cutting is of great antiquity, and is pursued with most success in Rome, where there are several very eminent artists now living. Cameos are of two descriptions, those cut in stone, or *pietra dura*, and those cut in shell. Of the first, the value depends on the stone, as well as in the excellence of the work. The stones most prized now are the oriental onyx and the sardonyx, the former black and white in parallel layers, the latter carnelian, brown and white; and when stones of four or five layers of distinct shades or colours can be procured, the value is proportionably raised, provided always that the layers be so thin as to be manageable in cutting the cameo so as to make the various parts harmonize. For example, in a head of Minerva, if well wrought out of a stone of four shades, the ground should be dark grey, the face light, the bust and helmet black, and the crest over the helmet brownish or grey. Next to such varieties of shades and layers, those stones are valuable in which two layers occur of black and white of regular breadth. Except on such oriental stones no good artist will now bestow his time; but, till the beginning of this century, less attention was bestowed on materials, so that beautiful middle-age and modern cameos may be found on German agates, whose colours are generally only two shades of grey, or a cream and a milk-white, and these not unfrequently cloudy. The best artist in Rome in *pietra dura* is the Signor Girometti, who has executed eight cameos of various sizes, from one and a half to three and a half inches in diameter, on picked stones of several layers, the subjects being from the antique. These form a set of specimens, for which he asks £3000 Sterling. A single cameo of good brooch size, and of two colours, costs £22. Portraits in stone by those excellent artists Diez and Saulini may be had for £10. These cameos are all wrought by a lathe with pointed instruments of steel, and by means of diamond dust.

Shell cameos are cut from large shells found on the African and Brazilian coasts, and generally shew only two layers, the ground being either a pale coffee-colour or a deep reddish-orange; the latter is most

prized. The subject is cut with little steel chisels out of the white portion of the shell. A fine shell is worth a guinea in Rome. Copies from the antique, original designs, and portraits, are executed in the most exquisite style of finish, and perfect in contour and taste, and it may be said that the Roman artists have attained perfection in this beautiful art. Good shell cameos may be had at from £1 to £5 for heads, £3 to £4 for the finest large brooches, a comb costs £10, and a complete set of necklace, ear-rings, and brooch, cost £21. A portrait can be executed for £4 or £5, according to workmanship.

Ed. New Philos. Jour.

On the Application of Water to Anthracite.

All persons who have been much accustomed to the use of anthracite for fuel seem to entertain an idea that the application of water has a beneficial effect. It is the invariable custom of the old inhabitants of the districts where no other fuel is used, to wet the coal before putting it on the fire. A wet paste of small culm, mixed with clay, makes a more lively and pleasant fire than small coal alone. This must arise from the clay retaining a portion of the water until decomposed by the ignited carbon of the coal producing the gases, carbonic oxide and carburetted hydrogen. It has been suggested that the application of vapour of water to anthracite fires in steam-boilers would supply the gaseous or volatile properties of bituminous coal; there is, however, much difficulty in the perfect development of the principle, arising from the compact structure of the coal, and the close manner in which the pieces of coal seem to adjust themselves in the fire. It is necessary that the coal be kept in an active state of combustion while the vapour is passing through, but so little passage being allowed through the fire, when the vapour of water is applied, it shuts off the supply of air, consequently the combustion is diminished. It requires both a very high temperature and a large quantity of pure air, with a full *quantum* of oxygen, to consume carburetted hydrogen—the most important of the two gases. Carbonic oxide burns at a very low temperature, and produces little heat. A quantity of flame may easily be produced by steam passing through an anthracite fire, but it is chiefly that of the latter gas, the former being volatilized without burning, and its powerful effect, consequently, lost. Besides the air necessary to keep up the combustion of the coal in the fire a large quantity is necessary to consume the gases, and that, too, at a high temperature. It appears impossible to attain these results with a common draught.

The writer, after considerable experience, is decidedly of opinion that anthracite cannot be used with advantage in ordinary boilers without a blast. When a blast is used, although it may be difficult, yet it is not impossible to devise a method of producing the full effect from the application of water to an anthracite fire; it is a subject of vast importance, and well worthy the attention of young mechanics and engineers—a fine field for the exercise of their ingenuity. It is quite certain that some anthracite contains ninety-five per cent. of pure carbon, and were it possible to render the entire effect of this

available, certain portions of it converted into volatile inflammable matter by its union with the elements of water, and steadily and continuously applied to the tube or flues of a boiler without loss, anthracite might be considered as a species of concentrated fuel—an invention of incalculable value for steamers going upon long voyages. When anthracite is used for blacksmith work, there is abundance of heat, but a large quantity of cinder is formed; this cinder has generally been considered as a mere oxide of iron, but it certainly contains carbon. It is the same cinder which is produced in large quantities in the refining process of iron works. Possibly oxygen and carbon, in the proportions to form carbonic oxide, are combined with the iron. A minute quantity of water running into a blacksmith's fire, when using anthracite, would remedy this—the presence of hydrogen preventing, in a great measure, the formation of the cinder. It is an axiom in the north of England, that a good gas coal is a good smith's coal, and *vice versâ*. It will be quite impossible to manufacture malleable or bar-iron of good quality, using anthracite for fuel, without the application of the vapour of water. This is a subject of the deepest interest to parties embarking in iron-works, where anthracite must be used for fuel. A patent for producing gas, by passing steam through a retort charged with anthracite, has been taken out by E. O. Manby, Esq., C. E., of Swansea—a gentleman possessing a thorough local knowledge of the anthracite district of South Wales, and who has had the best opportunities of judging of the powers and capabilities of the coal. He produces gas of great illuminating power rapidly and abundantly, which requires no purification. It seems likely that the distinguishing feature in the difference of the several varieties of coal depends upon the presence of the elements of water, either entire or in varying proportions, that are combined with the carbon—anthracite being quite free from them. It is a fair speculation to imagine that the anthracite veins of coal at some period possessed bituminous properties, but that being more immediately acted upon by volcanic commotion, all volatile matter was expelled, while extraordinary pressure being applied left the coal a solid compressed mass of carbon, constituting the peculiar characteristic of anthracite. Mining Jour.

Physical Science.

Electrotype.

The Bavarian sculptor, Stigelmayer, has brought to great perfection the galvano-plastic process. In the space of two or three hours colossal statues in plaster are covered with a coat of copper, which takes with the greatest accuracy the most minute and delicate touches, giving the whole the appearance and solidity of the finest casts in bronze. M. Stigelmayer has also applied his process to the smallest objects, as flowers, plants, and even insects, bringing them out with such accuracy, that they seem to have been executed by the hands of the most skilful artists.—*Letter from Munich.*

Mech. Mag., Sept., 1841.

Meteorological Journal for 1841, *kept at the Lancaster Conservatory of Arts & Sciences, Lancaster, Pa., by* Washington L. Atlee, M. D., *Obs.*

1841.		Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 p.m			Sky.				Winds.				Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew point.	Diff bet. dew pt. & therm.	Wet bulb.		7 A.M D's	2 P.M D's	9 P.M D's		7 A.M D's	2 P.M D's	9 P.M D's	7 A.M D's	2 P.M D's	9 P.M D's	Rain gauge In's.
January.	Average	29.51	29.45	29.56				26.05	35.33	31.92	23.69	29.37	25.53	9.88	32.63	Ent. clr	3	1	10	N.	2	1	2	1	0	0	
																				N. W.	6	5	8	2	0	1	
	Maximum	30.14	30.15	30.10				46.50	55.00	50.00	36.00	45.50	55.00	47.21	55.00	Ent.cld	17	19	16	N. E.	8	8	7	0	0	0	
																				S.	0	3	1	0	0	0	
	Minimum	28.92	28.91	28.78				-7.00	7.50	-1.00	-7.00	3.75	-29.71	0.00	7.50	Prt. clr.	11	10	4	S. W.	6	5	5	2	1	2	
																				S. E.	2	1	3	0	0	0	
	Range	1.22	1.24	1.32				53.50	47.50	51.00	43.00	41.75	84.71	47.21	47.50					W.	4	5	4	3	8	1	
																				E.	3	2	0	0	0	0	
Omitted			1	1					1	1		1	1	1	1			1	1			1	1	20	21	17	6.430
February.	Average	29.32	29.29	29.32				25.04	36.39	27.16	22.43	29.38	22.51	13.86	32.14					N.	0	4	1	0	0	0	
																				N. W.	5	7	10	2	7	1	
	Maximum	29.73	29.67	29.64				40.00	54.00	41.00	36.00	42.75	37.36	28.97	45.00	Ent. clr	8	5	18	N. E.	7	4	3	0	0	0	
																				S.	1	0	2	0	0	0	
	Minimum	28.79	28.86	28.89				3.00	13.00	4.00	2.00	7.50	1.82	0.00	12.00	Ent.cld	9	7	6	S. W.	12	6	5	1	1	1	
																				S. E.	0	0	3	0	0	0	
	Range	.94	.81	.75				37.00	41.00	37.00	34.00	35.25	35.54	28.97	33.00	Prt. clr.	11	16	4	W.	3	6	4	8	7	2	
																				E.	0	1	0	0	0	0	
Omitted																								10	8	6	1.150
March.	Average	29.47	29.41	29.41				35.10	49.16	38.63	32.05	41.60	31.00	18.20	41.85					N.	4	3	5	2	0	0	
																				N. W.	2	4	4	4	2	2	
	Maximum	29.84	29.79	29.74				56.50	73.00	61.00	53.00	64.00	63.51	38.15	67.00	Ent. clr	7	7	11	N. E.	7	6	7	1	1	0	
																				S.	3	2	3	0	0	0	
	Minimum	28.75	28.83	28.59				18.50	28.00	25.00	18.50	26.50	1.15	0.00	25.50	Ent.cld	13	12	11	S. W.	5	5	1	0	3	0	
																				S. E.	2	1	4	1	0	0	
	Range	1.09	.96	1.15				38.00	45.00	36.00	24.50	37.50	64.66	38.15	41.50	Prt. clr.	11	12	6	W.	6	7	3	7	9	3	
																				E.	2	3	4	0	0	0	
Omitted																								9	9	15	4.057

Meteorological Journal – Continued.

1841.		Barometer.			Attached Thermometer.			External Thermometer.					Hygr'm'tr, 2 p.m.			Sky.				Winds.				Clouds.			Rain.
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Dew Point.	Diff. bet. dew pt. & therm	Wet bulb.		7 A.M D's	2 P.M D's	9 P.M D's		7 A.M D's	2 P.M D's	9 P.M D's	7 A.M D's	2 P.M D's	9 P.M D's	Rain gauge. In's.
April.	Average	29.43	29.45	29.41	46.70	55.48	48 88	45.00	55.29	46.22	40.55	47.53	44.83	10.69	49.94					N.	1	1	3	0	2	0	
																				N.W.	7	7	8	6	7	2	
	Maximum	29.94	29.92	29.91				61.00	70.00	60.50	55.00	62.00	63.08	32.04	65.00	Ent. clr	5	2	8	N. E.	9	3	3	1	2	0	
																				S.	2	2	3	0	2	0	
	Minimum	28.53	28.57	28.63				31.50	37.00	32.00	29.00	33.75	23.09	0.00	37.00	Ent.cld	16	10	12	S. W.	4	5	3	4	1	0	
																				S. E.	4	4	8	0	2	0	
	Range	1.41	1.35	1.28				29.50	33.00	28.50	26.00	28.25	39.99	32.04	28.00	Prt. clr.	9	16	10	W.	1	3	1	6	5	3	
																				E.	2	3	1	0	1	0	
Omitted			2						2			2	3	3	3			2				2		9	6	17	3,956
May.	Average	29.41	29.40	29.42	55.40	67.16	59.52	54.87	67.87	56.59	49.21	58.53	50.21	17.68	58.08					N.	4	2	2	1	0	1	
																				N.W.	7	14	9	10	15	4	
	Maximum	29.66	29.64	29.60				71.00	84.50	73.00	66.50	75.25	68.56	31.69	73.00	Ent. clr	8	2	8	N. E.	4	3	5	1	1	0	
																				S.	1	3	3	0	0	0	
	Minimum	28.94	28.96	28.89				34.00	47.00	37.00	30.00	40.00	33.23	0.00	43.00	Ent.cld	10	5	7	S. W.	8	5	5	3	8	1	
																				S. E.	5	3	6	0	2	1	
	Range	.72	.68	.71				37.00	37.50	36.00	36.50	35.25	35.33	31.69	30.00	Prt. clr.	13	24	16	W.	2	1	1	4	5	0	
																				E.	0	0	0	1	2	0	
Omitted																								4		17	2,360
June.	Average	29.46	29.45	29.44	69 27	80.30	74.13	67.78	80.80	70.22	64.62	72.54	63.00	17.82	68.90					N.	5	2	1	0	3	0	
																				N.W.	3	3	7	2	3	2	
	Maximum	29.60	29.65	29.63				77.00	92.00	80.00	73.00	81.50	73.51	32.37	76.00	Ent. clr	12	8	10	N. E.	3	3	3	2	0	0	
																				S.	5	6	3	1	1	0	
	Minimum	29.27	29.25	29.21				57.00	63.00	58.00	54.00	62.50	50.76	0.00	62.00	Ent.cld	12	5	7	S. W.	5	5	9	4	5	3	
																				S. E.	6	2	6	1	2	0	
	Range	.33	.40	.42				20.00	29.00	22.00	19.00	19.00	22.75	32.37	14.00	Prt. clr.	6	17	13	W.	3	8	1	2	7	1	
																				E.	0	1	0	0	0	0	
Omitted																								6	3	15	3.755

1841.		Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet dew point and therm	Hygr'm'tr, 2 P.M. Wet bulb.	Sky.	Sky. 7 A.M D's	Sky. 2 P.M D's	Sky. 9 P.M D's	Winds.	Winds. 7 A.M D's	Winds. 2 P.M D's	Winds. 9 P.M D's	Clouds. 7 A.M D's	Clouds. 2 P.M D's	Clouds. 9 P.M D's	Rain. Rain gauge In's.
July.	Average	29.54	29.53	29.52	69.29	82.55	72.18	68.74	82.26	70.37	65.61	73.94	59.59	21.44	68.19					N.	4	1	4	1	3	0	
																				N.W.	7	9	6	7	6	0	
	Maximum	29.85	29.81	29.82				80.00	92.50	80.00	78.00	83.75	74.17	27.47	78.00	Ent. clr	12	2	14	N. E.	4	3	2	1	2	0	
																				S.	3	5	2	0	1	0	
	Minimum	29.27	29.27	29.33				60.00	70.00	61.50	55.00	66.00	45.58	0.00	59.00	Ent.cld	4	2	4	S. W.	11	7	9	3	2	0	
																				S. E.	1	0	5	0	1	0	
	Range	.58	.54	.49				20.00	22.50	18.50	23.00	17.75	28.59	27.47	19.00	Prt. clr.	15	27	13	W.	1	5	3	8	14	2	
																				E.	0	1	0	0	0	0	
Omitted.																								2	1	15	1.430
August.	Average	29.61	29.61	29.60	68.50	79.68	72.87	66.10	79.97	69.27	64.08	71.88	62.96	17.00	68.65					N.	1	3	2	0	2	1	
																				N.W.	3	4	2	0	2	1	
	Maximum	29.85	29.84	29.85				75.00	89.00	77.50	72.50	79.25	72.93	26.53	75.00	Ent. clr	5	2	10	N. E.	4	5	5	2	3	0	
																				S.	4	8	5	0	3	0	
	Minimum	29.47	29.46	29.45				58.00	68.00	62.50	57.00	62.50	53.48	5.72	62.00	Ent.cld	8	4	7	S. W.	7	3	5	8	4	0	
																				S. E.	8	3	8	0	3	0	
	Range	.38	.38	.40				17.00	21.00	15.00	15.50	16.75	19.45	20.81	13.00	Prt. clr.	18	24	13	W.	0	2	2	9	8	3	
																				E.	4	2	2	2	5	1	
Omitted			1	1					1	1		1	1	1	1			1	1			1	0	6	4	15	3.835
September.	Average	29.52	29.51	29.52	64.23	74.29	67.35	61.48	74.84	63.78	59.93	67.38	62.48	12.36	66.72					N.	3	2	3	0	1	0	
																				N.W.	6	6	5	1	1	2	
	Maximum	29.80	29.79	29.80				71.50	88.00	77.50	71.50	78.25	73.50	21.85	74.00	Ent. clr	11	4	15	N. E.	4	3	7	0	2	0	
																				S.	2	6	3	0	4	0	
	Minimum	29.14	29.16	29.22				49.00	58.50	50.00	48.00	56.75	48.89	0.00	55.00	Ent.cld	11	8	7	S. W.	5	3	2	2	4	3	
																				S. E.	5	4	6	1	1	0	
	Range	.66	.63	.58				22.50	29.50	27.50	23.50	21.50	24.61	21.85	19.00	Prt. clr.	8	17	8	W.	1	3	1	7	7	0	
																				E.	4	2	3	0	4	0	
Omitted			1						1			1	1	1	1			1				1	0	8	3	10	2.200

Meteorological Journal—Continued.

1841.		Barometer. 7 A.M.	2 P.M.	9 P.M.	Attached Thermometer. 7 A.M.	2 P.M.	9 P.M.	External Thermometer. 7 P.M.	2 P.M.	9 P.M.	Reg'r.	Mean	Hygr'm'tr, 2 P.M. Dew point.	Diff. bet. dew point and therm.	Wet bulb.	Sky.	7 A.M D's	2 P.M D's	9 P.M D's	Rain. Rain gauge In's.
October.	Average	29.53	29.51	29.51	45.31	55.70	48.75	42.40	56.12	45.25	40.69	48.32	43.30	11.98	50.38					
	Maximum	29.88	29.90	29.90				58.00	66.00	58.00	56.50	60.25	64.00	24.63	64.00	Ent. clr	13	4	14	
	Minimum	28.93	28.96	28.97				30.00	41.50	30.50	27.00	35.75	25.76	0.00	36.00	Ent.cld	5	6	6	
	Range	.95	.94	.93				28.00	24.50	27.50	29.50	24.50	38.24	24.63	28.00	Prt. clr.	13	20	10	
Omitted			1	1					1	1		1	1	1	1			1	1	1.835
November.	Average	29.44	29.40	29.42	40.73	46.93	42.20	38.15	46.59	39.48	35.35	40.78	37.26	9.29	42.76					
	Maximum	29.96	29.90	29.91				59.50	72.00	62.00	55.50	63.75	67.52	27.55	69.00	Ent. clr	4	1	10	
	Minimum	28.97	28.90	29.01				17.00	30.00	21.00	16.00	25.75	16.62	0.00	27.00	Ent.cld	14	9	10	
	Range	.99	1.00	.90				42.50	42.00	41.00	39.50	38.00	50.90	27.55	42.00	Prt. clr.	12	19	10	
Omitted			1						1			1	1	1	1			1		3.127
December.	Average	29.44	29.41	29.42	33.42	39.42	36.82	29.73	39.10	33.74	28.12	33.65	31.20	7.96	36.47					
	Maximum	30.03	30.06	30.07				46.50	54.00	53.00	50.50	47.50	51.00	27.36	51.50	Ent. clr	10	4	7	
	Minimum	28.80	28.77	28.87				10 50	24.50	19.00	10.50	17.75	9.25	0.00	22.00	Ent.cld	13	12	13	
	Range	1.23	1.29	1.20				36.00	29.50	34.00	40.00	29.75	41-75	27.36	29.50	Prt. clr.	8	14	11	
Omitted			1						1			1	1	1	1			1		3.295

1841.	Winds.	7 A.M D's	2 P.M. D's	9 P.M D'a	Clouds. 7 A.M D's	2 P.M D's	9 P.M D's
October.	N.	6	4	7	0	4	0
	N. W.	7	12	8	5	9	0
	N. E.	3	2	2	1	1	0
	S.	2	4	3	0	0	0
	S. W.	9	6	7	3	2	0
	S. E.	0	0	0	0	0	0
	W.	3	1	3	6	8	2
	E.	1	1	0	0	0	0
Omitted			1	1	3	3	15
November.	N.	5	3	2	1	3	0
	N. W.	5	10	7	7	5	1
	N. E.	5	4	6	0	0	0
	S.	2	4	3	0	1	0
	S. W.	8	6	5	3	3	1
	S. E.	1	0	2	0	0	0
	W.	4	1	4	3	6	1
	E.	0	1	1	0	0	0
Omitted			1		12	11	17
December.	N.	3	2	4	0	1	1
	N.W.	4	8	7	2	6	2
	N. E.	3	4	6	0	0	0
	S.	2	2	3	0	0	0
	S. W.	9	5	3	4	3	0
	S. E.	3	2	2	1	0	0
	W.	4	6	6	4	6	0
	E.	3	1	0	0	1	0
Omitted			1		10	10	21

Average of 1841.

1841.	Barometer. 7 A. M.	Barometer. 2 P. M.	Barometer. 9 P. M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff. bet. dew point and therm.	Hygr'm'tr, 2 P.M. Wet bulb.
Average	29.475	29.452	29.462				46.70	57.81	49.39	43.86	51.24	44.49	14.01	51.31
Maximum	30.14	30.15	30.10				80.00	92.50	80.00	78.00	83.75	74.17	47.21	78.00
Minimum	28.53	28.57	28.59				-7.00	7.50	-1.00	-7.00	3.75	-29.71	0.00	7.50
Range	1.61	1.58	1.51				87.00	85.00	81.00	85.00	80.00	103.88	47.21	70.50
Omitted		8						8	3		8	9	9	9

Total of 1841.

Sky.	7 A.M. D's	2 P.M. D's	9 P.M. D's
Ent. clr	98	42	135
Ent. cld	132	99	109
Prt. clr.	135	216	118
Omitted		8	3

Winds.	Winds. 7 A.M. D's	Winds. 2 P.M. D's	Winds. 9 P.M. D's	Clouds. 7 A.M. D's	Clouds. 2 P.M. D's	Clouds. 9 P.M. D's	Rain. Rain gauge. In's
N.	38	28	36	6	19	2	
N.W.	62	89	81	48	63	18	
N. E.	61	48	55	9	12	0	
S.	27	45	34	1	12	0	
S. W.	89	61	59	37	37	11	
S. E.	37	10	53	3	11	1	
W.	32	18	33	67	90	18	
E.	19	18	11	3	13	1	
Omitted		8	3	99	76	180	37.430

Average of Winter Months, 1840–41.

Winter, 1840–41.	Barometer. 7 A. M.	Barometer. 2 P. M.	Barometer. 9 P. M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff. bet. dew point and therm.	Hygr'm'tr, 2 P.M. Wet bulb.
Average	29.43	29.39	29.45				25.09	35.76	28.89	22.70	29.17	24.80	10.98	32.49
Maximum	30.14	30.15	30.10				46.50	55.00	50.00	36.00	45.50	55.00	17.21	55.00
Minimum	28.79	28.78	28.78				-7.00	7.50	-1.00	-7.00	3.75	-29.71	0.00	7.50
Range	1.35	1.37	1.32				53.50	47.50	51.00	43.00	41.75	84.71	47.21	47.50
Omitted		1	1					1	1		1	1	1	1

Total of Winter Months, 1840–41.

Sky.	7 A.M. D's	2 P.M. D's	9 P.M. D's
Ent. clr	22	13	45
Ent. cld	35	35	30
Prt. clr.	33	41	14
Omitted		1	1

Winds.	Winds. 7 A.M. D's	Winds. 2 P.M. D's	Winds. 9 P.M. D's	Clouds. 7 A.M. D's	Clouds. 2 P.M. D's	Clouds. 9 P.M. D's	Rain. Rain gauge. In's
N.	5	6	4	2	1	0	
N.W.	18	20	27	7	12	4	
N. E.	21	16	15	0	0	0	
S.	4	5	7	0	0	0	
S. W.	22	17	13	4	2	3	
S. E.	3	1	7	0	0	0	
W.	14	21	16	21	23	6	
E.	3	3	0	0	0	0	
Omitted		1	1	36	39	32	11.880

Average of Spring Months, 1841.

Spring, 1841.	Barometer. 7 A. M.	Barometer. 2 P. M.	Barometer. 9 P. M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff. bet. dew point and therm.	Hygr'm'tr, 2 P.M. Wet bulb.
Average	29.44	29.42	29.41				44.99	57.44	47.15	40.60	49.22	42.01	15.52	49.96
Maximum	29.94	29.92	29.91				71.00	84.50	73.00	66.50	75.25	68.56	38.15	73.00
Minimum	28.53	28.57	28.59				18.50	28.00	25.00	18.50	26.50	1.15	0.00	25.50
Range	1.41	1.35	1.32				52.50	56.50	48.00	48.00	48.75	67.41	38.15	47.50
Omitted		2						2			2	2	2	2

Total of Spring Months, 1841.

Sky.	7 A.M. D's	2 P.M. D's	9 P.M. D's
Ent. clr	20	11	27
Ent. cld	39	27	33
Prt. clr.	33	52	32
Omitted		2	

Winds.	Winds. 7 A.M. D's	Winds. 2 P.M. D's	Winds. 9 P.M. D's	Clouds. 7 A.M. D's	Clouds. 2 P.M. D's	Clouds. 9 P.M. D's	Rain. Rain gauge. In's
N.	9	6	10	3	2	0	
N.W.	16	25	21	20	24	8	
N. E.	20	12	15	3	4	0	
S.	6	7	9	0	2	0	
S. W.	17	15	9	7	12	1	
S. E.	11	8	18	1	4	1	
W.	9	11	5	17	19	6	
E.	4	6	5	1	3	0	
Omitted		2	0	22	15	49	10.373

Meteorological Journal—Continued.

Average of Summer Months, 1841.

Summer, 1841.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff. bet. dew point and therm	Hygr'm'tr, 2 P.M. Wet bulb.
Average	29.54	29.53	29.52	69.02	80.84	73.06	67.54	81.01	69.95	64.77	72.79	61.85	18.75	68.58
Maximum	29.85	29.84	29.85				80.00	92.50	80.00	78.00	83.75	74.17	32.37	78.00
Minimum	29.27	29.25	29.21				57.00	63.00	58.00	54.00	62.50	45.58	0.00	59.00
Range	.58	.59	.64				23.00	29.50	22.00	24.00	21.25	28.59	32.37	19 00
Omitted		1	1					1	1		1	1	1	1

Total of Summer Months, 1841.

Sky.	7 A.M D's	2 P.M D's	9 P.M D'
Ent. clr	29	12	34
Ent.cld	24	11	18
Prt. clr.	39	68	39
		1	1

Winds.	Winds. 7 A.M D's	Winds. 2 P.M D's	Winds. 9 P.M D's	Clouds. 7 A.M D's	Clouds. 2 P.M D's	Clouds. 9 P.M D's	Rain. Rain gauge. In's.
N.	10	6	7	1	8	1	
N.W.	13	16	15	9	11	3	
N.E.	11	11	10	5	5	0	
S.	12	19	10	1	5	0	
S.W.	23	15	23	15	11	3	
S.E.	15	5	19	1	6	0	
W.	4	15	6	19	29	6	
E.	4	4	2	2	5	1	
		1	0	14	8	45	9.020

Average of Autumnal Months, 1841.

Autumn, 1841.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Attached Thermometer. 7 A.M.	Attached Thermometer. 2 P.M.	Attached Thermometer. 9 P.M.	External Thermometer. 7 A.M.	External Thermometer. 2 P.M.	External Thermometer. 9 P.M.	External Thermometer. Reg'r.	External Thermometer. Mean	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff. bet. dew point and therm	Hygr'm'tr, 2 P.M. Wet bulb.
Average	29.50	29.47	29.48	50.09	58.97	52.77	47.34	59.18	49.50	45.32	52.16	47.68	11.21	53.29
Maximum	29.96	29.90	29.91				71.50	88.00	77.50	71.50	78.25	73.50	21.63	74.00
Minimum	28.93	28.90	28.97				17.00	30.00	21.00	16.00	25.75	16.62	0.00	27.00
Range	1.03	1.00	.94				54.50	58.00	56.50	55.50	52.50	56.88	24.63	47.00
Omitted		3	1					3	1		3	3	3	3

Total of Autumnal Months, 1841.

Sky.	7 A.M D's	2 P.M D's	9 P.M D'
Ent. clr	28	9	39
Ent.cld	30	23	23
Prt. clr.	33	56	28
		3	1

Winds.	Winds. 7 A.M D's	Winds. 2 P.M D's	Winds. 9 P.M D's	Clouds. 7 A.M D's	Clouds. 2 P.M D's	Clouds. 9 P.M D's	Rain. Rain gauge. In's.
N.	14	9	12	1	8	0	
N.W.	18	28	20	13	15	3	
N.E.	12	9	15	1	3	0	
S.	6	14	9	0	5	0	
S.W.	22	15	14	8	9	4	
S.E.	6	4	8	1	1	0	
W.	8	5	8	16	21	3	
E.	5	4	4	0	4	0	
		3	1	23	17	42	7.162

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1841.
With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Jacquard Machinery for Weaving all kinds of figured goods;* Alexander Calderhead, city of Philadelphia, February 3.

The patentee says—"The nature of my improvement consists, first, in lifting and lowering the threads of the warp with what I call independent metallic heddles, or heylds, instead of the weights, males and twines composing the lower mountings, or harness, of the draw loom. Second—In constructing the cylinder, or pattern, so as to directly lift and receive the said heddles, to form the sheed, or shive; or in constructing a trunk and pattern web, both to direct what shall be the sheed as it does in the Jacquard and other drawing machines by trapping or untrapping the hooks, or knot cords, to be drawn up."

"I claim, as my invention, the principle of lifting the sheed, or shive, with metallic heddles directly by the pattern apron and trunk, roll or receiver, or by lowering the heddles into the same, as described."

2. For a machine for *Manufacturing Cannon Balls, Bullets, and other kinds of Shot* from malleable iron; Lewis Grandy and Thomas Osgood, city of Troy, Rensselaer county, New York, February 3.

"The metal from which the ball, or bullet, is to be made by means of our machine, is first to be formed into round bars of a size adapted to the kind of shot to be formed. When these are to be made of malleable iron, the metal must, preparatory to its being passed into the machine, be brought to a degree of heat nearly equal to that requisite for welding, in a suitable forge, or furnace, prepared for that purpose. When the balls, or bullets, are to be made from lead, or other soft metal, the heating process is omitted. The machine consists of suitable cutters for cutting off the proper quantity of metal from the bar to form a single ball, or shot, and of an apparatus for receiving the piece so cut off, and rolling it into the spherical form. The rolling is effected by means of channeled pieces of cast iron, or steel, which we will denominate swages. The channels in these, when the swages are made straight, are semi-cylindrical, and by placing swages in pairs, one over the other, with their channels coinciding, a cylindrical cavity is thereby formed. These swages may be either straight or circular; and to one, or to both, of each pair, a longitudinal, reciprocating, or a revolving, motion, as the case may be, must be communicated by suitable machinery.

"Having thus fully described the nature of our machine for manu-

facturing ball and shot, and shown the manner in which the same operates, we do hereby declare that we do not claim either of the separate parts thereof as of our invention, nor do we intend to limit, or confine ourselves to the particular manner of connecting or giving motion to the respective parts, but to use any of the devices, or means, for effecting these objects known to machinists; but what we do claim as constituting our invention, is the manner in which we have combined the cutting apparatus for separating the pieces of metal from the bars, with the reciprocating straight swages, or with revolving swages, or with straight and revolving swages combined, in such manner as that the pieces of metal cut off and to be rolled into balls, shall pass successively between two or more pairs of swages, in a machine constructed and operating substantially in the manner of that herein described."

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3. For an improvement in the manner of forming *Blocks of Wood for Pavements;* Stephen Carey, New Orleans, Louisiana, February 3, 1841. Patented for fourteen years from the 29th of January, 1839, the date of the English Patent.

"In forming my blocks for paving, I first cut them rectangularly, taking squared timber, generally of from nine inches to a foot, more or less, on each side, which timber I cross-cut into such lengths as may be thought suitable, according to the climate and other circumstances; these lengths, varying usually from nine to sixteen inches, those of the greatest length being required in climates where the ground is subject to be frozen to a considerable depth. The rectangular blocks, prepared as above described, are to be sloped, or beveled, on each of their four sides, said slopes or bends meeting at, or near, the middle of the length of each block, in consequence of which they become either wider or narrower in their measurement across the middle of each of their faces, than they are at their ends. In preparing my blocks I give to them three different forms, these being all that are necessary to their being combined together; one of these forms being that which would result from the uniting of two truncated rectangular pyramids by their larger ends; a second form is that which would be produced by joining such truncated pyramids by their smaller ends; and the third is a combination of the other two forms, two of its opposite sides having the first, and its other two sides the second forms."

Claim.—"Having thus fully described the manner in which I form and combine my blocks for the construction of pavements, what I claim as constituting my invention, and desire to secure by letters patent, is the giving to their sides, where they come into contact with each other, concave and convex faces, alternately, in the manner herein fully set forth, by which mode of forming and combining them they are each supported by, and aid in supporting, the surrounding blocks, as described; it being distinctly understood that when one side of a block is convex its opposite side is so likewise, and vice versa."

4. For improvements in the machine for *Splitting Leather, or Green Hides;* Alpha Richardson, Boston, Massachusetts, February 9.

The above named patent is for improvements on the machines that split the leather by means of a vibrating knife.

The gauge roller, which is placed above the knife to gauge the thickness of the grain side of the leather, works on pivot screws at each end, that pass through two arms projecting from a tubular shaft, within which a shaft revolves to communicate motion to the gauge roller by means of two chain bands, one at each end, that pass through openings in the tubular shaft. The table, or bed, against which the cutting is effected, rests on springs, and on its upper surface there is a revolving, elastic, steel rod, against which the flesh side of the leather is borne, and which yields to the inequalities in the surface of the leather. The split leather, or skin, is drawn through, to feed the machine, by means of three rollers geared together.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined the gauge roller, the shaft by which it is driven, and the tubular shaft, so as to give the revolving motion to the gauge roller by means of the chain bands. I claim, also, the use of the elastic steel rod, in combination with the elastic plate, or table, arranged and operating as described. I claim, likewise, the combining with such a machine, the drawing, or feeding rollers, operating in the manner, and for the purpose set forth. I do not claim to have invented any thing new in the general mode of gearing or of employing springs, and adjusting screws, these being common to machines used for the same, and for other purposes, but I confine my claim to the particulars above stated, with such variations thereof as will be substantially the same, producing a like effect by analogous means."

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5. For improvements in *Smelting Iron Ores;* Charles Sanderson, Sheffield, England, February 9.

"The object of my invention for certain improvements in the art or process of smelting iron ores, is to separate the scoria, slag, or other earthy or extraneous matters, from the metallic parts of such ores in a better and more economical manner than is commonly practiced in the smelting of iron ores, and the invention embraces a novel or improved manner, or method, of treating or operating upon such ores, whereby I am enabled to separate and remove the scoria, or earthy matters, contained therein, from the metallic parts, without the necessity of carbonizing the metallic parts so thoroughly as to cause them to melt together into a fluid state as they do in the common blast furnace; but my method consists in carbonizing the metallic parts to that extent which will enable them to separate from the scoria during the process of melting, whereby I am enabled to separate the metallic parts from the scoria without the necessity of melting both at the same time into a fluid state and running off the fluid iron from the scoria, or slag, as is the usual practice in the blast furnace; that is to say, I so treat and operate upon the ore, that I reduce the scoria, or other

extraneous matters contained therein, to a fluid state, so that the same will separate from the metallic parts and run off, leaving the metal without its changing into a fluid form—but in a sort of pasty consistency and in a fit state to be removed from the furnace, and applicable to various purposes, particularly to the making of bar iron."

The claims refer throughout to numerous drawings, and are therefore omitted.

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6. For improvements in *Locomotive Engines for Railways;* Henry Waterman, city of Hudson, Columbia county, New York, February 9.

The character of this invention is given with sufficient clearness in the claims made, which are as follows: "What I claim as my invention, and desire to secure by letters patent, is the particular mode of connecting the rear and front driving wheels by means of jointed rods placed at each end of said axle, so constructed as to enable the wheels to have a lateral and vertical motion to enable them to accommodate themselves to the curvature of the track, and pass over whatever obstacles may intervene without danger to the engine. And in connecting the main boxes of the main driving axle to the base of the cylinder, or other convenient place, by jointed rods so as to hold them firmly, and thus resist the strain on the axle and joints of the ordinary frame produced by the oscillating action of the pistons and their connexions; and thereby to dispense with the usual frame and pedestals, which, with the boxes, are constantly liable to wear, from the causes before stated; and I claim the above mentioned improvements whether they are effected in the manner herein set forth, or in any other mode substantially the same, and the last named improvement to be applied also to engines having but one pair of driving wheels."

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8. For an improvement in the machine for *Scraping Skins, or Hides, preparatory to Tanning;* Reuben Shailer, Haddam, Connecticut, February 9.

This improvement was added to a patent granted to Reuben Shailer on the 19th of June, 1837, noticed in this Journal, vol. xvii, 2nd series, p. 178. The improved apparatus consists of a cylinder with knives, scrapers, stones, or brushes, on its surface, against which the skin is pressed by means of a piece of leather attached to a hinged frame.

Claim.—"Having thus fully described the nature of my improvements in the within described machine for unhairing, scraping, and performing other analogous operations upon hides and skins, what I claim therein, and desire to secure by letters patent, is the affixing of the knives, scrapers, or other instruments, on to the periphery of a cylinder, in combination with a hinged frame sustaining a piece of leather, or other yielding material, the whole being constructed, arranged, and operating substantially in the manner herein set forth."

8. For improvements in *Piano Fortes;* Timothy Gilbert, Boston, Massachusetts, February 10.

Without the drawings we could not give a clearer idea of these improvements than will be conveyed by the claim alone, which is as follows:

Claim.—"Having thus described my improvements I shall claim the above arrangement of the parts of the action by which the spring after the strings are struck by the hammers performs the three operations of throwing back the hammer and preventing its recoil, throwing forward the damper upon the strings, and depressing the rear end of the key lever, consequently raising the opposite, or key, end; the whole being constructed and operating substantially as herein set forth. I also claim the mode of adjusting the end, or cloth, of the damper to the string, by means of a piece of wood, or spring, applied to the rear end of the key lever, and raised or lowered by a screw; and also the mode of adjusting the height of the jack by a similar contrivance applied to the same end of this key lever, the whole being arranged substantially as above described."

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9. For an improvement in the *Hammer Heads of Piano Fortes;* Timothy Gilbert, Assignee of Edwin Fobes, Boston, Massachusetts, February 10.

Claim.—"I claim forming the top of the hammer heads of piano fortes of cork, over which the soft buff leather, or striking part of the head, is to be stretched and confined in the usual manner."

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10. For an improvement in the *Cocks of Hydrants;* Ebenezer Hubball, Assignee of Joseph Martin, city of Baltimore, February 10.

The improvement is in the mode of raising the valve from its seat, which is effected by means of a screw-cap, turned by a winch, which works on a screw cut on the upper end of the valve rod.

Claim.—"The invention claimed, and desired to be secured by letters patent, consists in lifting the valve vertically, without any horizontal or grinding movement on its seat, by means of the before described revolving screw-cap and screw-head piston (valve) rod, whether constructed and arranged precisely in the manner above described, or in any other mode substantially the same."

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11. For improvements in *Clocks;* Aaron D. Crane, Newark, New Jersey, February 10, 1841; antedated December 22, 1840.

This clock, instead of being regulated by the vibrations of a pendulum, is regulated by the twisting and untwisting of a narrow strip of steel, to the lower end of which, a spherical weight is suspended. The twisting and untwisting of the strip of steel, which constitutes the pendulum rod, is effected by an arrangement of levers connected with the escapement wheel, but in a manner not easily explained in words without drawings. A rotary hammer, also, is employed in the striking

part, instead of the ordinary reciprocating hammer; this hammer is hung by a joint pin to the upper end of a vertical spindle, and is provided with a counter weight to balance it—both the hammer and counter weight, when lying horizontally, may rotate under the bell without striking it, but immediately in front of the bell there is a short inclined plane, which elevates the hammer sufficiently to cause it to strike as it approaches the bell, and then permits it to fall.

The time, or watch, part is driven by a spring, which is wound up by the striking of the clock, and the striking part is driven by a large spring, which is to be wound up in the usual way. On the arbor of one of the wheels in the train of the striking part, there is a barrel containing the spring of the time part, which barrel is connected with the train of the time part; this spring is attached to the arbor of the wheel in the striking train, and its other end forms the connexion with the time part by friction against the inner periphery of the barrel; when the clock strikes, this spring will consequently be wound up, and any excess of winding will be counteracted by the slipping of the spring on the inner periphery of the barrel.

Claim.—"The invention claimed, and desired to be secured by letters patent, is: first, the rotary pendulum; second, the rotary hammer in the striking part of the clock, and thirdly, the connection between the striking and time part of a clock, by which the time part is driven, all as described, and for the purpose above set forth."

In the construction of this time piece there is considerable ingenuity displayed, but we apprehend that the skill of the inventor would have been more profitably directed in the improving and manufacturing of clocks operated by the ordinary pendulum, which his tortion pendulum is hardly destined to supersede.

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12. For an improvement in the *Weighing Apparatus;* Christopher Edward Dampier, Ware, England, February 12.

A wheel or disk is hung by its axis to a suspended frame, provided with a pointer to indicate the graduations of pounds, &c., marked on the disk, as it turns under the action of the weights. A weight is attached by a joint pin to one disk, and on its opposite edge is the zero mark, from which commences the scale of pounds, and of parts thereof; the parts being so arranged as that when the whole is suspended, the weight shall be at the bottom, and zero under the pointer just above it. The dish, or scale, is hung to the edge of the wheel at right angles to the line, or diameter, running through the weight and zero of the scale. By attaching a lever to the disk in the line of its centre, the weights and dishes can be hung at different distances from the centre, and it thus acts as a steel yard, in addition to the constantly increasing weight or scale.

Claim.—"Now whereas, I claim as my invention, the application of a geometric scale, formed on the principle of the rules herein before given to a circular plate or disk, such plate or disk acting at the same time as a bent lever, and an equipoised balance beam for weighing

matter in the manner herein before described, and as an index of the weight so ascertained. And I claim also as my invention, the combination in operation of the aforesaid disk, acting as a bent lever, and the simple lever or steel yard as described, for ascertaining the weight of substances applied thereto, by means of graduated scales, as herein before mentioned, extending the operation of the disc acting as a bent lever to greater weights than marked upon the disc by means of the simple lever, or common steel yard."

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13. For an improvement in the *Corn Sheller;* Nicholas Goldsborough, Easton, Talbot county, Maryland, February 12.

This corn sheller consists of a cylinder armed with teeth in the usual way, which act in conjunction with a concave in stripping the grain from the cob. The concave is formed of a series of fluted iron rollers, twisted so as to make the flutes spiral; these are arranged in a frame hung on springs, within the frame of the machine.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the concave, consisting of revolving, twisted, fluted bars, and hung upon springs, in combination with the toothed cylinder, for the purpose and in the manner above specified."

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14. For an improvement in the *Plough;* Benjamin F. Jewett, Springfield, Sangamon county, Illinois, February 12.

The mould board of this plough is fastened to the sheath by rivets, which are cast with the sheath. The claim is confined to this mode of fastening the two parts together.

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15. For an improvement in the manner of constructing *Door and other Locks;* Solomon Andrews, Perth Amboy, Middlesex county, New Jersey, February 12.

The patentee says—"I denominate this lock 'the combined snail wheel lock,' which name is given to it on account of its principal characteristics being the causing of the key to carry around with it any desired number of wheels formed of flat plates of metal, which wheels revolve upon a centre pin, and are each of them perforated with a snail-like, or other suitably formed opening, within and upon which the bit of the key is to act."

The snail-like openings in all the wheels are alike, and the key is formed with projections on the bit of different lengths, one for each wheel, and as the key is turned, the projections being of different lengths, they will act upon the snail-like openings at different parts, and then carry the wheels around. Each of these wheels is provided with a recess so situated, as that when the projections on the bit of the key are all in contact with the wheels upon which they act, the recesses will all correspond, and receive the end of a pendulous lever, which is set in motion by the continued turning of the wheels, by which means the bolt of the lock is shot forward.

Claim.—"What I claim as new, and desire to secure by letters patent, are the use and employment of said combined wheels, having in them openings similar to those herein described, which wheels are to be operated upon within the snail-formed, or other, openings, and carried round to different distances by projecting pieces on the bit of the key, until a notch, or cavity, on the periphery of each wheel is brought to coincide with those on the other wheels with which it is combined, so as to admit of the opening of the lock, in the manner, or upon the principle, above set forth."

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16. For an improvement in the *Cooking Stove;* Clark Robinson, Union Town, Fayette county, Pennsylvania, February 13.

There is in this stove an arrangement of flues and dampers, by which the draught may be carried around the four sides of the oven in two different directions. The oven is below the fire chamber, and extends beyond it at the back of the stove, the plate that covers the flue at this part being provided with boiler holes, in addition to those directly over the fire. The chimney is situated behind the fire chamber, and over that part of the oven which extends in the rear of it. The bottom plate of the fire chamber does not extend to the back plate, and the intervening space is covered by a damper hinged to the back plate, and shutting down on a flanch on the back edge of the bottom plate. The back plate of the fire chamber is provided with four apertures, one on each side of the chimney, leading into the back flue, and two leading into the chimney, one of them above, and the other below, the bottom plate. From the above arrangement, it follows that, when the damper, which covers the opening in the bottom of the fire chamber, is thrown up, and thus closes the aperture in the back above the bottom plate, the smoke, &c., will pass out through this opening over the oven, down the front, along under the bottom, up the back, over so much of the top as extends back of the fire chamber, and then out at the chimney. When the damper is down and closes the opening in the bottom of the fire chamber, and the aperture leading into the chimney above the bottom of it, which is used only when kindling the fire, is closed, and the lower one leading into the chimney, and the two leading into the back flue are open, and the bottom of the chimney is closed; the smoke, &c., will then pass out from the fire chamber into the back flue, down the back, under the bottom, up the front, over the top, and then out into the chimney.

Under the hearth, and against the plate which forms the front flue, there is a square box, constituting an apparatus for roasting coffee, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before mentioned arrangement, to give the flame, &c., any direction, forward or backwards, round the oven, by means of flues and dampers connected therewith, and the additional apparatus which is heated by the oven and hearth for roasting coffee, and for using as a spit as described."

17. For an improvement in the *Press for compressing Cotton, &c.*; Lemuel Bolles, Jedediah Prescott, and William A. Bickford, Memphis, Shelby county, Tennessee, February 13.

There is in this press a combination of jointed levers, press-blocks, a rack and pinion, and other devices, connected in such a manner as not to admit of a description in words alone, and the claims, which refer throughout to the drawings, would not convey any idea of the particulars of the invention.

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18. For an improvement in the mode of *Applying water to Fire Engines*, so as to render their operation more effective; Franklin Ransom and Uzziah Wenman, city of New York, February 13.

The pressure of a column of water, either from a reservoir or a hydrant, is to be applied by a pipe, or hose, to the cylinder, or cylinders of a fire engine, so that the pressure of the column may assist the power, or force, applied to the brake or levers.

Claim.—"What we claim as our invention, and wish to secure by letters patent, is the employing of the pressure of a column of falling water, or the tendency of the hydraulic pressure on water at rest, to assist in the working of fire engines, by combining a hose or pipe, conducting said water with the receiving tubes of an engine or pump, operated by animal or mechanical power, the same being constructed substantially in the manner set forth."

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19. For an improvement in the *Parlor Stove;* John Backus and Evans Backus, New York city, February 18.

The patentees say—"The nature of this stove consists in a combination of the radiator and the hollow base, by which combination the smoke is made to descend through the sides or ends of the stove into the hollow base, and to ascend thence through a draught pipe at the back of the stove; and while in this passage the smoke heats the air, which is constantly passing through the radiators, which are open at bottom and top, to allow free way for the atmosphere of the room."

"What we claim as our invention, and desire to have secured to us by letters patent, is the combination of the hollow base and the radiators."

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20. For an improvement in the *Fire Engine;* Asa Barrett, city of Baltimore, February 18.

The patentee observes that "the usual manner of ejecting water from the engine, is by means of the goose-neck pipe, which is from five to eleven feet long; the bore having a uniform taper through its whole length. Whereas, I contract the length of the joints and the eject-pipe to the short length of from fourteen to seventeen inches: the eject-pipe itself being from three to six inches long." To a pipe, connected with the engine by the usual lower joint of the branch pipe. (which the patentee calls the eject pipe,) a short cylinder is attached

at right angles to the length of the pipe. The branch pipe, which is very short, is attached to a cylinder which turns within that first named, the branch pipe passing through a slot in it of sufficient length to allow the pipe to play through a range of a quarter of a circle: the inner cylinder has a long opening in it to admit the water from the main pipe. The inner cylinder is provided with gudgeons at each end, that pass through the heads of the first mentioned cylinder, and these have a lever attached to them for the purpose of governing the elevation of the branch pipe.

Claim.—"I claim as my invention, and desire to secure by letters patent, the combination of the eject-pipe as above described, with a compact universal joint-pipe or duct, managed by a handle or lever, all constructed in the manner, and for the purpose above specified."

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21. For improvements in the machine for making *Cotton Roping,* commonly called "Counter twist Speeders;" Charles Danforth, Paterson, Passaic county, New Jersey, February 18.

Those who are acquainted with the operation of speeders will fully understand this invention from the following claim, viz:—"What I claim as my invention, consists of the following arrangement, viz: the turning of the cylinder which bears and drives the bobbins in a direction which makes the roping run on to the bobbins at the point of contact or bearing, between the bobbins and the said driving cylinder, the roping being made to pass between the condensing belt, or through the condensing tube, to said point of contact, in the direction of a tangent to said driving cylinder, whereby the bobbins take the roving at such a distance from the nearer edge of the said belt or tube, as to be within the length of the fibre, and thereby the roping is not liable to be strained after passing upon the bobbin, as may be the case in machines, which deliver the roving through guides to the top or sides of the bobbins; the guides in my machine being made to deliver the roping filament to the condensing belt, and this being placed on a line with the top of the driving cylinder, so as to deliver the roping as near as may be in the direction of a tangent, as aforesaid."

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22. For improvements in machinery for *Trimming Straw Braid;* Henry H. Robbins, Middleborough, Plymouth county, Massachusetts, February 18.

This machine is for the purpose of trimming the long and the short ends of straw left on the two surfaces after braiding, the short ends being left on one side, and the long ends on the other.

The claim presents the general arrangement of the parts of this apparatus as clearly as can well be done, without a drawing.

Claim.—"I claim as my invention, the combination of a revolving circular saw with a riser, (so called) and a spring and gauge, the whole being arranged and operating substantially as herein above described, for the purpose of separating the long ends from the braid; and I also claim separating the short ends from the braid on the opposite side of

the same, by means of a circular saw in combination with a small metallic roller, bed knife and gauge, the arrangement and operation being substantially as specified."

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23. For an improvement in the *Nurse Bottle*, denominated a Lacteal or Artificial Breast; Charles M. Windship, Roxbury, Norfolk county, Massachusetts, February 18.

"The great objection to the common nursing bottle is, that it is exceedingly difficult to teach most infants to use them, and with many it is altogether impracticable. The peculiar formation of my lacteal breast remedies this objection and enables me to practice a useful deception, viz: inducing the child to think that it derives its nourishment directly from the mother, as it feeds in the natural position."

The bottle is made concave on the under side to rest on the breast, and on the upper side swelled out in form of the natural breast, with a neck in the middle, in the form of a nipple, and a tube at one side through which the milk is introduced.

Claim.—"I shall claim as my invention a nurse-bottle, shaped and curved in its several parts, so as to be used at the breast, and formed with a neck and mouth substantially as described. And I also claim in combination with the above, an artificial nipple, composed of sponge and wash leather, the whole forming what I denominate a lacteal or artificial breast, as above specified."

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24. For improvements in the *Press for filling War Rockets;* Alvin C. Goell, Washington city, District of Columbia, February 18.

"What I claim as constituting my invention in the above press, and desire to secure by letters patent, is the manner of combining a system of weighted levers with a screw, by causing a piston, or rod, to extend through a tubular opening in said screw, the lower end of said piston, or rod, acting against a follower, rammer, or other device analogous thereto in character and use, and its upper end acting upon a system of compound levers, by which the actual amount of pressure made may be ascertained and determined, substantially in the manner, or upon the principle, set forth. I also claim the manner of combining two, or more moulds, to be alternately brought under the pressing screw and piston, by the revolution of the basis on which they are situated, so that those not under the press, may be prepared for its action during the time of making pressure upon that which is in the proper situation."

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25. For an improvement in the *Cooking Stove;* Jefferson Cross, Morrisville, Madison county, New York, February 18.

The improvement referred to is added to a patent granted to the same person on the 27th of June, 1838, and noticed in this Journal, vol. xxiii, 2nd series, p. 400.

The patentee says—"In my stove, as originally constructed, there was a cylindrical elevated oven which was supported on two pillars,

or pipes, about one foot five or six inches in length, and when baking was to be effected, the heated air from the fire was allowed to pass up through these pipes and to circulate around the oven, as in some other stoves with elevated ovens. For carrying the draught directly into the main flue, when the oven was not to be used, it was led off by a flue projecting about one foot backwards from the body of the stove. By my present improvement I dispense with the pipes, or tubes, which sustained the oven, and conducted the heated air into the flue surrounding it; said oven being elevated above the top plate of the stove but little more than its diameter. I have also arranged the flue for carrying off the smoke and heated air in such manner as to change the direction of the draught by the action of a single valve, or damper, instead of by three, as in my former plan. The oven flue and stove flue communicate with each other through an opening nearly the whole length of the oven. Directly in front of the oven a pipe extends from the stove flue to a box above the oven, (the upper plate of which is provided with boiler holes) which communicates with the upper part of the oven flue and with the chimney; where the oven flue runs into the box it is provided with a damper to direct the draught either through the oven flue or through the front pipe, under the boilers, in the top plate of the box."

"What I claim, and desire to secure by letters patent, is the manner in which I have combined the elevated oven with the stove, by admitting the draught from the fire to pass from the stove directly into the oven flue through an opening extending nearly the whole length of the oven, as set forth. I also claim the manner of arranging and combining the flue, (pipe in front of the oven,) the box, and the valve, so as to direct the draught, by the shifting of said valve, either around the oven or through the pipe, for the purpose, and substantially in the manner, herein described."

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26. For an improvement in the *Machine for Inking Types;* Frederick J. Austin, city of New York, February 20.

This patent is taken for an alleged improvement in the well known inking apparatus of the printing press, and consists in an arrangement of levers, &c., for moving the inking roller over the form.

An arm extending from the sliding frame that carries the inking roller, is jointed to a lever attached to an arbor, from which projects another and shorter lever, at right angles to the first. The last mentioned lever is connected by means of a connecting rod, with a crank, the shaft of which is provided with a pulley and weight, by which the roller, when liberated, is moved over the form of types.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar mode of throwing the roller across the form by means of the lever and connecting rod combined and attached to the crank on the shaft of the pulley; said pulley being operated upon by the weight."

27. For an improvement in *Grinding Mills;* Ezekiel G. Ward, city of New York, February 20.

This grinding mill is a modification of the cast iron mill, the runner of which operates vertically. The improvements are clearly explained in the following claim, viz:—

"I am aware," the patentee observes, "that mills have been made with the grinders revolving vertically, and that the grinders of mills have been made so that they shall be removed from the shaft, and these I do not therefore claim as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the manner in which the grinders are connected with the case and shaft so that they can be removed with pleasure and without injury to any part of the mill; that is to say, I claim connecting the front grinder with the case by means of the steps fitting into notches in the mill case, in combination with the method of attaching the back grinder to the shaft by means of the flanch on the shaft having notches into which fit steps projecting from the back of the grinder, the shaft passing through the two grinders by which they are centered, and the grinding being regulated by pressing the flanch against the back of the back grinder, all as described."

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28. For an improvement in the *Stump Extractor;* Belden B. Mason, Randolph, and Mathews Joslyn, Napoli, Cattaraugus county, New York, February 20.

The improvement here patented is on that kind of stump machine in which the stump is extracted by means of a screw attached to it by means of chains, and passing through a nut attached to the upper part of a frame.

The patentee says—"We do not claim as our invention the method of extracting stumps by means of a screw passing through the nut in the upper part of the frame, as this has been before effected; but in these cases the nut being permanently and immovably fixed to the frame, the screw was liable to be bent, and therefore what we claim as our invention, and as an improvement on such a machine, is the employment of the semi-spherical nut and socket in combination with the screw and chain by which the stump is griped, for the purpose and in the manner specified."

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29. For an improvement in *Head Blocks for Saw Mills;* James King, Sapling Grove, Washington county, Tennessee, February 20.

The object of the improvement in the head blocks of saw mills, is the gauging the thickness of the board to be cut, and this is to be effected by means of a block of wood furnished with a slot, through which a screw bolt passes to fasten it to the head block, and to allow it to slide towards, or from, the saw. The distance of this block from the saw is regulated by a wedge which is driven in between it and a standard attached to the head block.

Claim.—"I am aware," the patentee observes, "that the head blocks

of saw mills have been provided with a sliding gauge for gauging the thickness of the board to be cut, and that the slide has been moved by a screw passing through a standard and acting on the sliding gauge, and that it has also been connected with a hinge frame by means of screws passing through a slot in the slide to allow of its sliding nearer to, or further from, the saw, and therefore I do not claim all this as of my invention; but what I do claim as my invention, and desire to secure by letters patent, is the peculiar manner in which I have constructed and combined the various parts, that is to say, I claim the sliding block, provided with a slot through which the screw bolt passes, to fasten it to the head block, in combination with the standard, the space between the two being occupied by a wedge to determine the thickness of the board to be cut, as described."

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30. For an improvement in the manner of *Fastening Bedsteads;* Hermann C. Ernst, Vandalia, Fayette county, Illinois, February 23.

In the improved mode of fastening, which is the subject of this patent, the posts are to be attached to the rails by a piece of cast iron, somewhat in the form of an anchor. That part which corresponds to the stem is round, and is received in a hole in the inner corner of the post, and each end of the head is provided with a round tenon, which is received in a hole made in the inner side of the rail. There are also two square tenons on the stem, within the anchor head, which fit into mortises in the rails, and come against the two inner sides, or faces, of the post.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the casting nearly in the shape of an anchor, for the purpose of confining the rails and posts of bedsteads to each other."

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31. For an improvement in *Making Brushes;* Robert B. Lewis, Hallowell, Kennebeck county, Maine, February 23.

This patent is for a mode of attaching the bristles, &c., to the handles of brushes for white washing and for such other purposes as require brushes to be wide and thin. The bristles are placed on each side of a double champfered bar, and are then confined by a metallic band, made in two parts and jointed at each end. In this manner the bristles are confined by being pinched between the side plates, or band, and the champfered bar.

Claim.—"Having thus described my improvements, I shall claim as my invention as follows, viz:—Confining the bristles in a brush (more effectually than before) by means of a double champfered bar, (whose section would be elliptical and on which the bristles are placed,) in combination with the metallic band, which is formed of two parts united by joints and pins, as described, the whole being arranged substantially in the manner and for the purpose set forth."

32. For improvements in *Machinery for Manufacturing Ploughs;* Draper Ruggles, Joel Nourse, and John C. Mason, Assignees of Elbridge G. Matthews, Worcester, Massachusetts, February 23.

The inventor says—"The nature of my invention consists in giving, by appropriate machinery, a uniform tenon and shoulder to the beam of each sized plough without the use of square, compass, or level; a method of cornering the beams in a manner befitting each size, and also a method of setting out the mortise in the handle and bringing all the parts together with an accurate fit, in conformity with such preparatory operations; altogether tending to the result above mentioned."

The claims refer throughout to the drawings, and could not be understood without them.

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33. For an improvement in the manner of *Fastening and Combining the Truss Frames of Bridges,* and which may be applied to other purposes; Jehu Price and James T. Phillips, Golden Post Office, Baltimore county, Maryland, February 23.

We make the following extract from the specification, viz:—"The peculiarity in the manner of fastening our truss frames and combining them with each other, consists in the employing of the pieces of timber last inserted in putting together the truss frame, in such a way as to cause them to operate as keys, and to bind the whole frame together without its being necessary to use pins, tree-nails, bolts, wedges, or other devices analogous thereto, excepting for fastening down the floor timbers, or such as may be employed in covering in. From the circumstance of these last inserted timbers keying the whole together in a manner similar to the binding together of the toy sometimes called a 'puzzle knot,' we have denominated our bridge the 'Puzzle Keyed Bridge.'"

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the within described manner of fastening, and combining together the truss frames of bridges, or of other structures, by the insertion of timbers which constitute key pieces, or cross ties, as set forth, so as to obviate the necessity of using pins, tree-nails, screw-bolts, or other analogous devices."

Report from the Commissioner of Patents, showing the operations of the Patent Office during the year 1841.

PATENT OFFICE, *January,* 1842.

SIR: In compliance with the law, the Commissioner of Patents has the honor to submit his annual report.

Four hundred and ninety-five patents have been issued during the year 1841, including *fifteen* additional improvements to former patents; of which classified and alphabetical lists are annexed, marked A and B.

During the same period, *three hundred and twenty-seven* patents have expired, as per list marked C.*

The applications for patents, during the year past, amount to *eight hundred and forty-seven;* and the number of caveats filed was *three hundred and twelve.*

The receipts of the office for 1841 amount to $40,413.01; from which may be deducted $9,093.30, repaid on applications withdrawn.

The ordinary expenses of the Patent Office for the past year, including payments for the library and for agricultural statistics, have been $23,065.87; leaving a surplus of $8,253.84 to be credited to the patent fund, as per statement marked E.

For the restoration of models, records, and drawings, under the act of March 3, 1837, $20,507.70 have been expended, as per statement marked F.

The whole number of patents issued by the United States, previous to January, 1842, is *twelve thousand four hundred and seventy-seven.*

The extreme pressure in the money market, and the great difficulty in remittance, have, it is believed, materially lessened the number of applications for patents. These have, however, exceeded those of the last year by *eighty-two.*

The resolution of the last Congress, directing the Commissioner to distribute seven hundred copies of the Digest of Patents among the respective states, has been carried into effect, as ordered.

Experience, under the new law reorganizing the Patent Office, shows the importance of some alterations in the present law. One difficulty has been hitherto suggested, viz: the want of authority to refund money that has been paid into the Treasury for the Patent Office, by mistake. Such repayment cannot now be made without application to Congress. The sums, usually, are quite small, not exceeding $30. A bill has been heretofore presented, embracing these cases, and passed one House of the National Legislature; but a general law would save much legislation, and be attended with no more danger than now attends the repayment of money, on withdrawing applications for patents. Indeed, several private petitions are now pending before Congress, and are postponed, to wait final action on the bill which has been so long delayed.

Frauds are practised on the community by articles stamped "pattent," when no patent has been obtained; and many inventors continue to sell, under sanction of the patent law, after their patents have expired. To remedy these evils, the expediency of requiring all patentees to stamp the articles vended with the date of the patent, and punishing by a sufficient penalty the stamping of unpatented articles as patented, or vending them as such, either before a patent has been obtained or after the expiration of the same, is respectfully suggested. Almost daily inquiries at the Patent Office exhibit the magnitude of such frauds, and the necessity of guarding effectually against them.

The justice and expediency of securing the exclusive benefit of new and original designs for articles of manufacture, both in the fine and

* For list marked C, see page 281; the others are omitted.

useful arts, to the authors and proprietors thereof, for a limited time, are also respectfully presented for consideration.

Other nations have granted this privilege, and it has afforded mutual satisfaction alike to the public and to individual applicants. Many who visit the Patent Office learn with astonishment that no protection is given in this country to this class of persons. Competition among manufacturers for the latest patterns prompts to the highest effort to secure improvements, and calls out the inventive genius of our citizens. Such patterns are immediately pirated, at home and abroad. A pattern introduced at Lowell, for instance, with however great labor or cost, may be taken to England in twelve or fourteen days, and copied and returned in twenty days more. If protection is given to designers, better patterns will, it is believed, be obtained, since the impossibility of concealment at present forbids all expense that can be avoided. It may well be asked, if authors can so readily find protection in their labors, and inventors of the mechanical arts so easily secure a patent to reward their efforts, why should not discoverers of designs, the labor and expenditure of which may be far greater, have equal privileges afforded them?

The law, if extended, should embrace alike the protection of new and original designs for a manufacture of metal, or other material, or any new and useful design for the printing of woolen, silk, cotton, or other fabric, or for a bust, statue, or bas-relief, or composition in alto or basso-relievo. All this could be effected by simply authorizing the Commissioner to issue patents for these objects, under the same limitations and on the same conditions as govern present action in other cases. The duration of the patent might be *seven* years, and the fee might be *one-half* of the present fee charged to citizens and foreigners, respectively.

On the first alteration of the patent law, I would further respectfully recommend, that authority be given to consuls to administer the oath for applicants for patents. Inventors in foreign countries usually apply to the diplomatic corps, who are willing to aid any, and have uniformly administered the usual oath prescribed by the Commissioner of Patents; but as the Attorney General has decided, that consuls cannot, within the meaning of the patent law, administer oaths to inventors, a great convenience would attend an alteration of the law in this respect.

It is due to the clerical force of the office to say, that their labors are arduous and responsible—more so than in many bureaux—while the compensation for similar services in other bureaux is considerably higher. A comparison will at once show a claim for increased compensation, if uniformity is regarded. The chief and sole copyist of the correspondence of this office receives only eight hundred dollars per annum.

The Commissioner of Patents also begs leave to suggest the expediency of including the annual appropriations for the Patent Office in the general bill which provides for other bureaux. Objections hitherto urged against this course, inasmuch as the Patent Office is embraced by a special fund, have induced the committee to report a spe-

cial bill, which, though reported without objection, has failed for two sessions, because the bill could not be reached, it having been classed with other contemplated acts on the calendar, instead of receiving a preference with other annual appropriations so necessary for current expenses. Were the appropriation for the Patent Office included in a general bill, also designating the fund from which it was to be paid, all objection, it is believed, might be obviated.

During the past year a part of the building erected for the Patent Office has, with the approbation of the Secretary of State, been appropriated to the use of the National Institute, an association which has in charge the personal effects of the late Mr. Smithson, collections made by the exploring expedition, together with many valuable donations from societies and individuals. While it affords pleasure to promote the welfare of that institution by furnishing room for the protection and exhibition of the articles it has in charge, I feel compelled to say that the accommodation now enjoyed can be only temporary. The large hall appropriated by law for special purposes will soon be needed for the models of patented articles, which are fast increasing in number by restoration and new applications, and also for specimens of manufacture and unpatented models. An inspection of the rooms occupied by the present arrangement will show the necessity of some further provision for the National Institute.

The Patent Office building is sufficient for the wants of the Patent Office for many years, but will not allow accommodation for other objects than those contemplated in its erection. The design of the present edifice, however, admits of such an enlargement as may contribute to its ornament, and furnish all necessary accommodation for the National Institute; and also convenient halls for lectures, should they be needed in the future disposition of the Smithsonian legacy. Whatever may be done as regards the extension of the present edifice, it is important to erect suitable outbuildings, and to enclose the public square on which the Patent Office is located.

Some appropriation, too, will be needed for a watch. So great is the value of the property within the building, that a night and day watch is indispensable. The costly articles formerly kept in the State Department for exhibition are now transferred to the National Gallery, where their protection will be less expensive than it was at the State Department, since these articles are guarded in common with others. The late robbery of the jewels, so termed, shows the impropriety of depending on bolts and bars, as ingenuity and depravity seem to defy the strength of metals. A careful supervision at all times, added to the other safeguards, is imperiously demanded. I am happy to say that no injury or loss will be sustained from the robbery just alluded to, with the exception of the reward so successfully offered for the recovery of the articles.

By law, the Commissioner is also bound to report such agricultural statistics as he may collect. A statement annexed (marked G) will show the amount of wheat, barley, oats, rye, buckwheat, Indian corn, potatoes, cotton, tobacco, sugar, rice, &c., raised in the United States

in the year 1841. The amount is given for each state, together with the aggregate. In some states the crop has been large, in others there has been a partial failure. Upon the whole, the year has been favorable, affording abundance for home supply, with a surplus for foreign markets, should inducements justify exportation.

These annual statistics will, it is hoped, guard against monopoly or an exorbitant price. Facilities of transportation are multiplying daily; and the fertility and diversity of the soil ensure abundance, extraordinaries excepted. Improvements of only ten per cent. on the seeds planted will add annually from fifteen to twenty millions of dollars in value. The plan of making a complete collection of agricultural implements used, both in this and foreign countries, and the introduction of foreign seeds, are steadily pursued.

It will also be the object of the Commissioner to collect, as opportunity offers, the minerals of this country which are applied to the manufactures and arts. Many of the best materials of this description now imported have been discovered in this country; and their use is only neglected from ignorance of their existence among us. The development of mind and matter only leads to true independence. By knowing our resources, we shall learn to trust them.

The value of the agricultural products almost exceeds belief. If the application of the sciences be yet further made to husbandry, what vast improvements may be anticipated! To allude to but a single branch of this subject. Agricultural chemistry is at length a popular and useful study. Instead of groping along with experiments, to prove what crops lands will bear to best advantage, an immediate and direct analysis of the soil shows at once its adaptation for a particular manure or crop. Some late attempts to improve soils have entirely failed, because the very article, transported at considerable expense to enrich them, was already there in too great abundance. By the aid of chemistry, the west will soon find one of their greatest articles of export to be oil, both for burning and for the manufactures. So successful have been late experiments, that pork (if the lean part is excepted) is converted into stearine for candles, a substitute for spermaceti, as well as into the oil before mentioned. The process is simple and cheap, and the oil is equal to any in use.

Late improvements, also, have enabled experimenters to obtain sufficient oil from corn meal to make this profitable, especially when the residuum is distilled, or, what is far more desirable, fed out to stock. The mode is by fermentation, and the oil which rises to the top is skimmed off, and ready for burning without further process of manufacture. The quantity obtained is ten gallons in 100 bushels of meal. Corn may be estimated as worth fifteen cents per bushel for the oil alone, where oil is worth $1.50 per gallon. The extent of the present manufacture of this corn oil may be conjectured from the desire of a single company to obtain the privilege of supplying the light-houses on the upper lakes with this article. If from meal and pork the country can thus be supplied with oil for burning and for machinery and manufactures, chemistry is indeed already applied most beneficially to aid husbandry.

A new mode of raising corn trebles the saccharine quality of the stalk, and, with attention, it is confidently expected that 1,000 pounds of sugar per acre may be obtained. Complete success has attended the experiments on this subject in Delaware, and leave no room to doubt the fact that, if the stalk is permitted to mature, without suffering the ear to form, the saccharine matter (three times as great as in beets, and equal to cane) will amply repay the cost of manufacture into sugar. This plan has heretofore been suggested by German chemists, but the process had not been successfully introduced into the United States, until Mr. Webb's experiments at Wilmington, the last season. With him the whole was doubtless original, and certainly highly meritorious; and, though he may not be able to obtain a patent, as the first original inventor, it is hoped his services may be secured to perfect his discoveries. It may be foreign to descend to further particulars in an annual report. A minute account of these experiments can be furnished, if desired. Specimens of the oil, candles, and sugar, are deposited in the National Gallery.

May I be permitted to remark that the formation of a National Agricultural Society has enkindled bright anticipations of improvement. The propitious time seems to have come for agriculture, that long neglected branch of industry, to present her claims. A munificent bequest is placed at the disposal of Congress, and a share of this, with private patronage, would enable this association to undertake, and, it is confidently believed, accomplish much good.

A recurrence to past events will show the great importance of having annually published the amount of agricultural products, and the places where either a surplus or a deficiency exists. While Indian corn, for instance, can be purchased on the western waters for one dollar (now much less) per barrel of 196 pounds, and the transportation, via New Orleans, to New York, does not exceed $1.50 more, the price of meal need never exceed from eighty cents to one dollar per bushel in the Atlantic cities. The aid of the National Agricultural Society, in obtaining and diffusing such information, will very essentially increase the utility of the plan before referred to, of acquiring the agricultural statistics of the country, as well as other subsidiary means for the improvement of national industry.

I will only add that, if the statistics now given are deemed important, as they doubtless may prove, to aid the Government in making their contracts for supplies, in estimating the state of the domestic exchanges, which depend so essentially on local crops, and in guarding the public generally against the grasping power of speculation and monopoly, a single clerk, whose services might be remunerated from the patent fund, to which it will be recollected more than $8,000 has been added by the receipts of the past year, would accomplish this desirable object. The census of population and statistics, now taken once in ten years, might, in the interval, thus be annually obtained sufficiently accurate for practical purposes.

All which is respectfully submitted.

Henry L. Ellsworth.

Hon. John White, *Speaker of the House of Representatives.*

List of American Patents that expired in the year 1841.

Alarm for coaches, W. Hunt, N. Y., July 30.
Andirons, constructing feet of brass, J. Griffiths, N. Y., March 15.
Andirons, pedestal, Edmd. Smylie, N. Y., Feb. 1.
Andirons, repairing and finishing, Edmd. Smylie, N. Y., Feb. 22.
Apple mill, H. E. Paine and S. H. Russell, Le Roy, Ohio, March 5.
Apples, machine for grinding, Const. Weeks, Paris, N. Y., April 9.
Aqueduct, J. M. Benham, Bridgewater, N. Y., Aug. 29.
Auger, screw, Judson Smith, Derby, Conn., July 13.
Axletrees and boxes, Cyrus Beach, Newark, N. J., June 26.
Bark mill, cast iron, Wm. Torrey, Westbrook, Me., Sept. 13.
Bed-sacking, mode of tightening, J. R. Simpson, Boston, Mass., July 10.
Bedsteads, sacking bottoms, &c., Dan. Powles, Baltimore, Md., Jan. 26.
Beehive, Cuthbert Wiggins, Fayette, Pa., Feb. 27.
Bellows, Jesse Dixon, Pittsborough, N. C. June 11.
Bellows, J. S. Wilberts, Chili, N. Y., June 12.
Beer, brewing spruce, Wm. Dezeau, Philadelphia, Pa., May 31.
Blower for coal grates, R. Fuller and T. Thomas, N. Y., May 22.
Blowing and striking for blacksmiths, L. Hoyt and E. Pierce, Poultney, N. Y. March 3.
Boat, passing canal locks, R. Graves, Brooklyn, N. Y., July 26.
Boats, for transporting on canals, &c., R. P. Bell, N. Y., July 13.
Bobbin, tube for spinning cotton, B. Hutchison, Philadelphia, Pa., Oct. 18.
Bogging machine, Squire Collins, Hillsdale, N. Y., Feb. 22.
Boilers for anthracite, J. Barker, Baltimore, Md., Feb. 7.
Boilers, supplying steam uniformly, I. Doolittle, Bennington, Vt., June 1.
Boilers, constructing steam, Eb. A. Lester, Boston, Mass., May 14.
Boilers for steam engines, J. Pool, Sheffield, England, May 14.
Boot, constructing, T. Thorp, Richmond co., N. C., Aug. 31.
Boot crimper, Saml. Moorehouse, Eastport, Me., June 19.
Boots or shoes, mode of holding, Saml. Nourse, Danvers, Mass., Dec. 8.
Boring earth, J. R. Failing, Canajoharie, N. Y., June 13.
Boring and tenoning machine, D. Sperry, Colchester, Conn., Feb. 18.
Boxes, self-fastening, T. Mussey, New London, Conn., June 11.
Brick frames, for raising portable, E. Mann and G. Hill, Rochester, N. Y., July 21.
Brick press, A. B. Crossman, Huntington, N. Y., Feb. 9.
Brick press, John Howe, Alna, Me., May 18.
Brick press and moulding, J. McDonald, N. Y., April 24.
Brick machine, D. Rising, Alchester. Vt., March 21.
Brick and tile machine, E. Fisk and B. Hinkley, Fayette, Me., Sept. 8.
Bricks, machine for mixing earth for, D. K. Hill, Richmond co., Geo., Feb. 17.
Bridges, Wm. Woodmansee, Kingston, N. Y., March 6.
Bridges, T. P. Bakewell, Pittsburg, Pa., May 15.
Bridges with draws, G. Wilkinson, White Creek, N. Y., May 5.

Bugle, Kent, R. Willis, West Point, N. Y., Nov. 10.
Building vessels, &c., T. W. Bakewell, Cincinnati, Ohio, Feb. 21.
Buildings, removing, Sim. Brown, N. Y., July 31.
Burning lime and bricks and boiling kettles, Sol. Hill, New Milford, Ct., Feb. 12.
Bush for millstones, Nat. Taylor, Urbana, N. Y., July 23.
Calicoes, etching steel mills for, D. H. Mason, Philada., Pa., Oct. 30.
Cane juice, clarifying, Wm. J. McIntoch, Georgia, March 7.
Card teeth, cutting, J. Lamb, Leicester, Mass., August 1.
Carding machine, Jno. Tilton, Newton, Conn., Sept. 8.
Carpeting, Jer. Bailey, Philadelphia, Pa., April 7.
Carriages, Theo. Brooks and D. W. Eames, Rutland, N. Y., Dec. 26.
Carriages, W. & J. Jessup, Guilford co., N. C., June 1.
Carts for removing earth, Jer. Price, Lockport, N. Y., May 18.
Cement, hydraulic, Ez. Guilford, Washington, D. C., Jan. 16.
Cement, imitation of marble, Ben. Trembly, N. Y., Nov. 13.
Cement, for roofs of houses, &c., Chs. Clinton, N. Y., July 13.
Chair, Edmund Daley, Baltimore, Md., Feb. 9.
Chair, repairing and finishing, Jacob Daley, Baltimore, Md., Feb. 22.
Cheese nets, L. M. Norton, Litchfield, Conn., June 4.
Chimneys, crank and wheel dampers for, J. Reilly and J. Flanagan, Waynesboro', Pa., March 10.
Chisel, bearded mortising machine, S. Metcalf, Wilmington, Vt., Jan. 17.
Churn, S. L. Bagley, Hillsdale, N. Y., March 24.
Churn, Levi Rosencrans, Urbana, N. Y., May 19.
Churn, E. Spain, Mount Holly, N. J., April 23.
Churn, D. Sheldon, Poultney, Vt., Sept. 13.
Churn, N. Whitney, Augusta, Me., May 7.
Churn, rocking, J. G. Phillip, Kinderhook, N. Y., Feb. 15.
Clock, wood wheel, 30 hours, H. G. Dyar, N. Y., Nov. 6.
Cloth sheering, J. Collins, Anson, Me., March 6.
Cloths, washing and scouring, J. Goulding, Dedham, Mass., July 12.
Cock for hydrants, valve, B. Stancliff, Philadelphia, Pa., May 15.
Combs, ornamenting, U. Bailey, West Newbury, Me., Nov. 15.
Combs, &c., rolling the backs of, N. Bishop, Danbury, Conn., Nov. 17.
Composition, marble, granite, &c., L. Mathey, Brooklyn, N. Y., Mch. 7.
Cooking apparatus, D. Westerfield, N. Y. March 24.
Copperas, making, I. Tyson, Baltimore, Md., Feb. 15.
Cordage, by machinery, R. Graves, Brooklyn, N. Y., July 25.
Cork cutter, Luther Hills, Boston, Mass., June 18.
Cork cutting machine, Geo. Rawlings, Philadelphia, Pa., Oct. 30.
Corn crusher, S. H. Gannett, Greenville, Tenn., May 25.
Corn sheller, Thomas Newman, Guilford co., N. C., Feb. 7.
Corn sheller, longitudinal, G. E. Waring, Poundbridge, N. Y., Mch. 16.
Cotton bagging, spinning, J. C. Dewees, Mason co., Ky., Dec. 28.
Cotton, cleaning Sea Island, Jesse Reed, Marshfield, Mass., Aug. 10.
Cotton, packing, Wm. Thomas, Richmond co., N. C., Feb. 15.
Cotton and hay press, T. D. Wilson, Corydon, Ind., June 6.
Cotton press, R. Jernigan, Waynesburg, N. C., May 15.

Cotton press, P. White, Chatham co., N. C., Feb. 19.
Cotton roving, Gilbert Brewster, Poughkeepsie, N. Y., March 28.
Cotton spindle, B. Brundred, Oldham, N. Y., July 14.
Culinary fixtures for anthracite, J. F. Walters, Philada., Pa., June 8.
Cutter, cant twist blade for, C. C. K. Beach, Portland, Me., Nov. 10.
Cutting machine for metals, J. H. Hall, Harper's Ferry, March 7.
Dearborns, balance on, S. Blaisdell, Lancaster, Ohio, Oct. 10.
Distilling, J. M. Aiken, Philadelphia, Pa., August 30.
Distilling, Wm. Coke, Cabinpoint, Va., Oct. 30.
Distilling, J. Lusk, Butler co., Ohio, Dec. 22.
Distilling by escape steam, D. Embree, N. Richmond, Ohio, Dec. 3.
Distilling spirits, fermenting and, I. Belknap, Millersburg, Pa., July 20.
Dividing engine for scales, S. Hedge, Windsor, Vt., June 20.
Dyeing and polishing leather, S. Couillard, Boston, Mass., June 27.
Earth from canals, hauling, O. Phelps, Lansing, N. Y., July 16.
Engines, constructing, E. A. Lester, Boston, Mass., May 14.
Fanning mill, Enoch Walker, Springfield, Pa., Sep. 20.
Flax dressing, H. Schoonhoven, Poultney, N. Y., Dec. 11.
Flax thrashing and breaking, P. Barker, Worthington, Ohio, Aug. 20.
Frame chain, David Lesley, N. Y., Nov. 19.
Fur cutting machine, M. Petre, Womelsdoff, N. Y., Dec. 20.
Fur, separating hair from, John McDonald, N. Y., Sept. 11.
Gas and heated air in aid of the power, M. Ward, Baltimore, Md., May 15.
Gas light from cotton seed, D. Olmsted, New Haven, Conn., July 21.
Gases procured in charring wood, S. J. Jones, Philada., Pa., Jan. 17.
Gate for canals, safety, Van Dorn and J. Glenn, N. Y., May 14.
Glass, combination of moulds in forming, G. and P. C. Dummer and J. Maxwell, Jersey City, N. J., Oct. 16.
Glass, moulds for preparing, P. C. Dummer, Jersey City, N. J., Oct. 16.
Glass knobs dressed at one operation, J. Robinson, Pittsburg, Pa. Oct. 6.
Grain, cleaning, J. Tyler, Claremont, N. H., May 11.
Grist mill, W. Adams, Guilford, N. C., July 18.
Grist mill, A. Bencine, Caswell, N. C., Jan. 16.
Grist mill, Wm. Benbow, Guilford co., N. C., Jan. 19.
Grist mill, A. and J. Coe, Guilford co., N. C., July 21.
Grist mill, A. Delap and A. Eve, Guilford co., N. C., May 31.
Grist mill, Wm. W. Forward, Hartford, Conn., June 18.
Grist mill, T. Newman, Guilford co., N. C., Feb. 6.
Grist mill, B. Overman, Greenbury, N. C., Sept. 28.
Grist mill, J. Robinson, Buckskin Township, Ohio, Dec. 14.
Grist mill, R. S. Thomas, Rockingham, N. C., June 4.
Grist mill, Wm. A. Turner, Plymouth, N. C., June 27.
Grist mill, crusher and sheller, J. G. Morse, Randolph co., N. C., March 20.
Grist mill, improvement on Mendenhall's, S. Lawing and J. Monteith, Statesville, N. C., June 11.
Grist mill, sugarloaf and, S. and P. Moore, Mt. Tirzah, N. C., June 15.
Gun lock, S. Cromwell, Edgecomb, Me., Feb. 3.
Gun lock, percussion, M. Davis, Mayville, N. Y., July 10.

Gun lock, percussion, Wm. A. Hart, Fredonia, N. Y., Feb. 20.
Hammer, foot trip, E. Pierce and J. Hathaway, Poultney, Vt., Oct. 19.
Harrow teeth, Wm. McConaughey, New Garden, Pa., Feb. 16.
Hat bodies, setting up, J. Grant, Providence, R. I., April, 10.
Hats, gearing of cones for bowing, T. F. Mayhew, Boston, Mass., Aug. 22.
Hats, stiffening of waterproof, S. Hemstead, Jr., St. Charles co., Mo., May 26 and Oct. 26.
Hatters' cards, or jacks, making, J. C. Seely, Dutchess co., N. Y., March 15.
Heat, evolution and management of, E. Nott, Schenectady, N. Y., May 30.
Heaving down vessels, J. Crowninshield, Salem, Mass., Oct. 19.
Hides, protecting from moths, Saml. Storm, N. Y., Feb. 17.
Hoes by rolling cast steel, } Chy. Bulkley, Colchester, Conn., Jan. 10.
Hoes, of cast iron, }
Hoes, harrows and ploughs, J. Cheatham, Providence Inn, Va., July 31.
Hoes, pronged, Jos. Wilson, Marlborough, N. H., Sept. 20.
Hoes, &c., ploughing and weeding, Wm. Carmichael, Sand Lake, N. Y., July 28.
Hollow ware, wooden, E. Briggs, Perry, N. Y., July 30.
Homony mill, Robt. Campbell, Martinsburg, Va., April 9.
Hoop and sheet iron manufactory, J. H. Pierson, Ramapo Works, N. Y., Dec. 24.
Horse yoke, Ad. Allen, Troy, N. Y., June 29.
Horse and hay rake, Jer. Bailey, Philadelphia, Pa., Mch. 30.
Hubs, cast iron, Benj. Lyman, Manchester, Ct., Nov. 6.
Hydraulic elevator, D. Corey, N. Y., Aug. 31.
Hydraulic machine, Jac. Roup, Kenhawa, Va., Oct. 6.
Inlaying gold in tortoise shell, U. Bailey, West Newbury, Me., Feb. 23.
Iron, rolling, Ab. S. Valentine, Bellefonte, Pa., June 3.
Jointing boards, El. H. Clarke, Damascas, Pa., Jan. 31.
Lamp for boiling water, T. G. Fessenden, Boston, Mass., Jan. 31.
Lathe for turning, Wm. Patrick, Leverett, Mass., April 24.
Leather, making water-proof, D. Kiser, N. Y., Nov. 19.
Lever gained power, E. G. Fitch, Blakely, Ala., Oct. 5.
Lime kiln, Abel Jeanes, Mill Creek Hundred, Del., Feb. 15.
Liquors, testing strength of, Wm. Cornell, Brooklyn, N. Y., Aug. 20.
Locks, J. Brown and G. W. Robinson, Providence, R. I., Feb. 20.
Locks, percussion, M. Davis, Mayville, N. Y., July 10.
Locks, percussion, Wm. A. Hart, Fredonia, N. Y., Feb. 20.
Locks, percussion, Jos. Shattuck, Jefferson co., Ohio, Nov. 10.
Locks, percussion lever, J. Ambler, Jr., S. New Berlin, N. Y., Oct. 16.
Locks, percussion magazine, J. B. Lowry, Mayville, N. Y., Sept. 11.
Loom for figured goods, H. Baker, North Salem, Aug. 31.
Loom, power, Wm. B. Leonard, Fishkill, N. Y., May 23.
Marine railway, Jos. Webb, N. Y., May 14.
Marine railway, J. Wood and P. A. Sabalan, N. Y., Oct. 6.
Mill, horizontal, Jon. Reynold, Amenia, N. Y., March 15.
Moccasins, water-proof, John Syms, N. Y., Nov. 14.

Mortar machine and grinding apples, J. H. Sheeler and J. S. Wilbert, Chili, N. Y., June 12.
Mortising machine, A. Greenleaf and H. Amidon, Mexico, N. Y. Dec. 28.
Mortising machine, Simon Le Roy, Mexico, N. Y., July 10.
Mortising and tenoning timber, J. McClintic, Chambersburg, Pa., March 31.
Navigation, improvement in, John J. Giraud, Baltimore, Md., Jan. 31.
Oil from flaxseed, D. Dodge, Hamilton, Mass., May 14.
Ovens, heating rooms, &c., Mich. Porteaux, Richmond, Va., Jan. 17.
Paddles, folding boat, E. Jenks, Colebrook, Conn., June 13.
Paddles, water, John J. Giraud, Baltimore, Md., Sept. 18.
Paint mill, Allen Holcomb, Butternuts, N. Y., May 14.
Paint mill, horizontal cast iron, O. Packard, Wilmington, Vt., Feb. 12.
Paper finishing, Ira White, Newburg, Vt., Feb. 28.
Paper machine trimming, J. McClintic, Chambersburg, Pa., Mch. 31.
Pianos, horizontal, T. Loud, Jr., Philadelphia, Pa., May 15.
Pipes, tubes, &c., Jos. Putnam, Salem, Mass., Jan. 17.
Piston, rotative, J. M. Cooper, Guildhall, Vt., July 16.
Plane or jointer irons, Chas. E. West, Colchester, Conn., Jan. 10.
Plane stocks of cast iron, H. Knowles, Colchester, Conn., August 24.
Plane, turner, sliding, Jon. Sparrow, Portland, Me., Dec. 26.
Planing machine, Jos. Rechm, Savage Factory, Md., Nov. 1.
Plough, Wm. Beach, Philadelphia, Pa., June 27.
Plough, R. Rhodes, Charlottesville, Va., Feb. 20.
Plough, angular, John Lupton, Va., July 31.
Plough, bar share, Eli Pugh, Chathan co., Conn., Dec. 24.
Plough, cast iron, R. Sweenney, Warren co., Ohio, May 18.
Plough, for planting corn, B. Murphy, Union District, S. C., Dec. 31.
Plough, for planting corn, H. Russell, Litchfield, Me., Jan. 16.
Plough, right and left, Geo. Dolfer, Frederick Town, Md., Aug. 20.
Plough, twin, N. G. Cryer, Wentworth, N. C., March 24.
Polishing hard and soft substances, B. Green, Hartford, Vt. Mch. 27.
Power by certain fluids, M. J. Brunel, London, England, Mch. 30.
Preserving butter, eggs, &c., H. Edmonston, Pike Creek, Md., Apr. 26.
Printing press, S. J. Couillard, Boston, Mass., July 14.
Propelling boats, Elisha Fuller, Providence, R. I., March 2.
Propelling boats, &c., Elijah Bryan, N. Y., Dec. 22.
Propelling machinery by weights, C. Broyles, Tellico, Tenn., Oct. 19.
Propelling machinery of all kinds, Wm. Stanton, Centre Township, Pa., April 23.
Pump, for steam boilers, A. Judson, Sweden, N. Y., Feb. 24.
Pumping vessels by wind power, T. Brownell, N. Y., March 23.
Railway carriage, R. P. Morgan, Stockbridge, Mass., July 27.
Rake, hand hay, A. Foster, Auburn, N. Y., Dec. 9.
Rake, hay and grain, M. and S. Pennock, East Marlboro', Pa., Feb. 17.
Rake and hoe handles, turning, { W. Shepperdson, Hamilton, N. Y., J. C. Sperry, Camden, N. Y., Dec. 3.
Rake and hoe handles, turning, A. Sperry, Rotterdam, N. Y., Dec. 26.

Rake teeth, turning tenons for, J. W. Sweet and W. Stedman, Berkshire, Mass., March 5.
Rice cleaning and hulling, J. Campbell, Winsborough, S. C., May 3.
Rice and coffee cleaning, E. Welder, Jersey City, N. J., Nov. 6.
Rooms, warming, A. S. McAllister and J. Iggett, Salem, N. Y., Dec. 15.
Rope layer, *(jack and breast work,)* D. Myerle, Philada., Pa., Mch. 3.
Sack shoulderer, L. Rice, Clarksborough, N. J., August 3.
Safety valve, chimney smoke, &c., J. H. Schreiner, Philadelphia, Pa., July 31.
Salt manufacture, B. Byington, Salina, N. Y., Feb. 21.
Saw mill, A. Bencine, Milton, N. C., June 4.
Saw mill, B. Overman, Greensbury, N. C., Dec. 11.
Saw mill, J. Spafford, Ipswich, Mass., June 23.
Saw mill, of Johnson's, A. B. Graham, Lee, Mass., Sept. 28.
Saw mill, reciprocating, Wm. Kendall, Waterville, Me., Dec. 31.
Saw mill, reciprocating, Wm. Kendall, Jr., Waterville, Me. Nov. 23.
Saw sett, spring, J. Baggs, Philadelphia, Pa., Oct. 4.
Saw, two edged, M. Cass and A. Bull, Caroline, N. Y., August 31.
Scagliola, shining, S. Pinistre, N. Y., June 18.
Scurvy, preventive from, J. M. Armour, Frederick Town, Md., Sept. 28.
Sheaves for shipping, cast iron, F. Seymour, Plymouth, Mass., Dec. 29.
Shingle machine, J. Daley, Baltimore, Md., Sept. 27.
Shingle machine, G. W. Dana, Rutland, Vt., Sept. 20.
Shingle machine, improvement on Hawes', G. A. Hoard, Antwerp, N. Y., Sept. 30.
Shingle, manufacturing, P. Hawes, Lockport, N. Y., March 30.
Shingle, manufacturing, O. Wheeler, Rochester, N. Y., Nov. 10.
Shingle, sawing machine, N. Swift, Lebanon, Conn., April 27.
Shovels, making, O. Ames, Easton, Mass., March 5.
Shuttle, mode of throwing, J. Goulding, Dedham, Mass., August 24.
Sleigh shoes, cast iron, E. Trask, Saugerties, N. Y., Oct. 6.
Sofa bedstead, J. R. Penniman, Boston, Mass., August 22.
Spectacles and single eye glasses, S. Newton, Washington, D.C., Dec. 22.
Spindles, preventing friction on, J. G. Sholtz, Rockaway Township, Ohio, July 6.
Spinner, Brown's vertical, H. Wilson, Pomfield, N. Y., July 13.
Spinner, family, Wm. Jones, Thornville, Ohio, July 27.
Spinner, for wool, B. Lapham, Queensbury, N. Y., June 29.
Spinning machine, N. Remington, Geneva, N. Y., April 21.
Spinning wool and cotton, W. Church, Birmingham, Eng., July 11.
Spur for bevel gearing, C. Neer, Waterford, N. Y., March 9.
Staves, preparing for truss hoop, A. Amsden, Bloomfield, N. Y., July 27.
Steam and rotary wheel, F. Harris, Albany, N. Y., July 10.
Steam engine, J. Maynard, Ovid, N. Y., June 15.
Steam engine, W. P. Wing, Newburg, Vt., August 17.
Steam, generating, L. Silliman, Albany, N. Y., Jan. 19.
Steam, heating by escape, A. Brown, N. Y., Oct. 30.
Steelyards, lever power, S. Andrews, Bridgetown, Me., March 24.

Still, M. McGregor, N. Y., June 15.
Stone, dressing, drilling and cutting, H. Bourne, Salem, Mass., Aug. 3.
Stone, hewing and hammering, C. B. Reed, West Bridgewater, Mass., June 27.
Stove, air funnel, H. Wales, Randolph, Mass., May 18.
Stove, cast iron foot, G. W. Robinson, N. Y., June 2.
Straw cutter, T. Benbow, Guilford, N. C., Feb. 16.
Straw cutter, L. Durham and J. H. Pleasants, Halifax co., Va., July 27.
Straw cutter and corn sheller, C. Chamberlain, Amenia, N. Y., Mch. 15.
Stumps, machine for raising, A. Pratt, Jackson, N. Y., August 17.
Suspenders, E. Chesterman, N. Y., June 19.
Suspenders, A. L. Van Horn, Philadelphia, Pa., Feb. 22.
Tailor's square, J. G. Wilson, N. Y., Feb. 28.
Tanning, O. Cogswell, Cincinnati, Ohio, Sept. 18.
Team scraper or shovel, G. Davis and J. Price, Lockport, N. Y., May 12.
Teeth, engrafting, E. A. Bigelow, Brandon, Vt., March 8.
Templets, spring, A. Jenks, and J. Clewell, Holmsburg, Pa., Mch. 19.
Thrashing machine, E. B. Pike, Litchfield, Me., Oct. 5.
Thrashing machine, vibrating, M. Pennock, Kennett's Square, Pa., May 26.
Thrashing, winnowing and flax breaking machine, E. Warren, N. Y., August 11.
Tide mill, R. Spedden, Talbot, Md., August 1.
Tire, bending, W. James, Ashford, Conn., July 14.
Tobacco, manufacturing, J. Ambler, Jr., Richmond, Va., April 3.
Tread wheel, C. Watson, Addison township, Ohio, Dec. 22.
Tubes of clay, machine for making, J. H. Rowen and H. Wise, Fredericktown, Pa., May 10.
Tubs, making wood sides of, J. Bailey, Philadelphia, Pa., April 7.
Type caster, mechanical, J. Sturdevant, and E. Starr, Boston, Mass., Oct. 23.
Vessels, raising by cradle screw, C. Miner, Lynn, Ct., Oct. 12 & Nov. 16.
Vessels, slinging yards of, I. Carver, Jr., Prospect, Me., Dec. 11.
Vests, spring stiffener for, J. D. Shute, Boston, Mass., Dec. 5.
Victualler, B. C. Burdett, N. Y., August 4.
Washing clothes and shelling corn, B. Rice, Denmark, N. Y., Nov. 23.
Washing machine, D. Beard, Buffalo, N. Y., June, 27.
Washing machine, M. Cass, Caroline, N. Y., July 29.
Washing machine, F. Kelsey, Middletown, Conn., Sept. 28.
Washing machine, C. Stone, Middleburg, Conn., Feb. 17,
Watch keys, J. S. Davis, Providence, R. I., April 3.
Watch seals, S. Davis, P. Babbett and H. P. Grunnell, Providence, R. I., March 3.
Water gate for penstocks or flumes, H. Potes, Christianburg, Va., Jan. 9.
Water gate, opening and shutting, O. Packard, Wilmington, Vt., Feb. 12.
Water power, apparatus to wheels, R. and T. McCulloch, Albemarle co., Va., May 26.
Water raised by revolving wheel, H. Miller, Allentown, Pa., July 28.

METEOROLOGICAL OBSERVATIONS FOR FEBRUARY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	32°	41°	30.00	30.10	W.	Brisk		Clear.	Clear.
☽	2	23	47	30.25	30.20	SW.	Moderate		Clear.	Clear.
	3	54	62	30.18	29.74	SW.	do	.64	Rain.	Rain.
	4	62	65	29.60	29.60	SW. W.	do	.10	Cloudy.	Cloudy.
	5	44	46	29.40	29.70	W.	Blust'ring		Flying cl'ds.	Flying clouds.
	6	31	53	30.10	29.15	W.	Brisk.		Clear.	Clear.
	7	42	45	29.70	29.60	SW.	Moderate	.25	Cloudy.	Rain.
	8	31	35	29 54	29.53	W.	Brisk.		Par. Cloudy.	Partially cloudy.
	9	14	26	30.10	30.10	W.	Moderate		Clear.	Clear.
	10	27	49	29.94	30.00	W. S.	do		Clear.	Clear.
⊗	11	34	54	30.10	30.10	S. SW.	Calm		Cloudy.	Lightly cloudy.
	12	44	54	29.80	30.85	W.	do	.94	Rain.	Cloudy.
	13	37	40	29.84	29.73	E.	do	.43	Rain.	Rain.
	14	44	45	29.60	29.55	W.	Blust'ring		Cloudy.	Cloudy.
	15	20	30	30.10	30 15	NW.	Moderate		Clear.	Clear.
	16	32	44	29.70	29.20	E.	do	.85	Snow.	Rain.
	17	14	20	29.45	30.16	W.	Blust'ring		Clear.	Clear.
☾	18	20	42	30.20	30.10	SE.	Moderate		Lightly cl'dy	Lightly cloudy.
	19	50	46	29.50	29.60	W.	Blust'ring		Rain.	Flying clouds.
	20	21	29	30.36	30.30	NW.	Moderate		Clear.	Lightly cloudy.
	21	21	38	30.10	30.10	W.	do		Clear.	Clear.
	22	24	38	29.93	29.93	E. W.	do		Cloudy.	Clear.
	23	25	37	30.05	30.10	W.	do		Clear.	Clear.
☉	24	28	47	30.04	30.04	SW.	Calm.		Clear.	Hazy.
	25	34	41	30.24	29.37	E.	Moderate		Hazy.	Cloudy.
	26	36	39	29.60	30.00	E. W.	do		Drizzle.	Rain.
	27	36	48	29.80	29.84	W.	do		Cloudy.	Flying Clouds.
	28	36	50	30.00	30.00	W.	do		Por. Cloudy.	Clear.
		32.71	43.25	29.90	29.89			2.31		

Thermometer.		Barometer.	
Maximum 65.00 on 4th. Minimum 14.00 on 9th and 17th.	Mean, 37.98.	Max. 30.85 on 12th. Min. 29.15 on 6th.	Mean 29.895

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

MAY, 1842.

Civil Engineering.

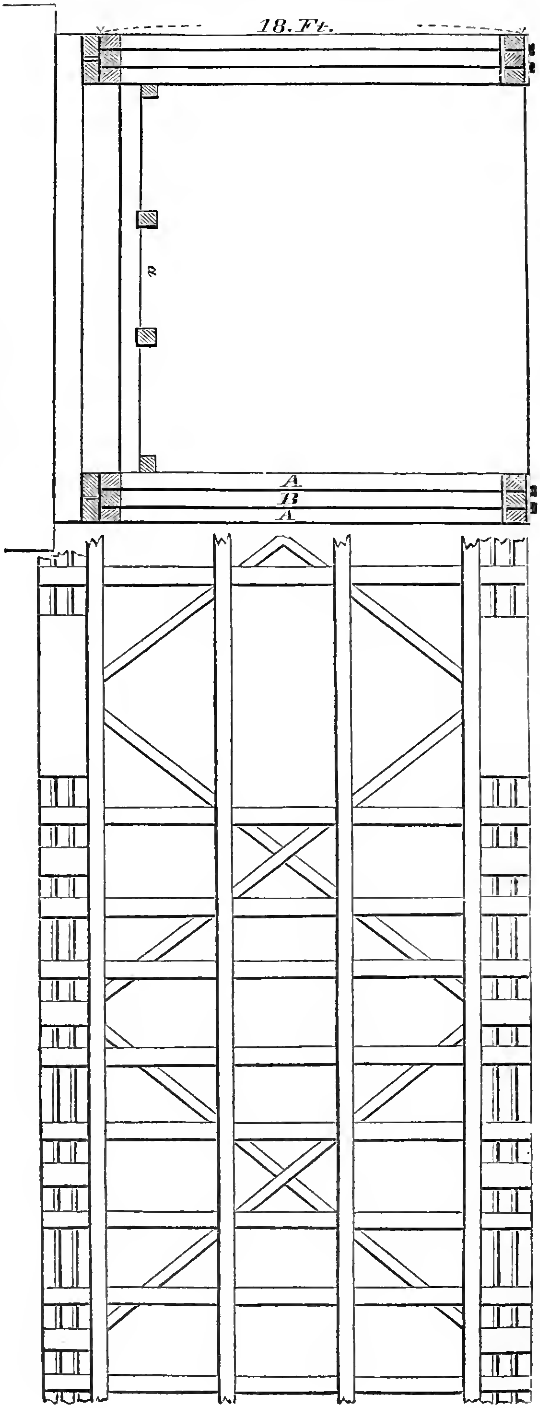
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of Howe's Patent Truss Bridge, carrying the Western Railroad over the Connecticut River at Springfield, Massachusetts. By* LEWIS M. PREVOST, JR., *C. E.*

The accompanying drawing is a representation of the bridge built across the Connecticut river at Springfield, Massachusetts, on the line of the Western railroad.

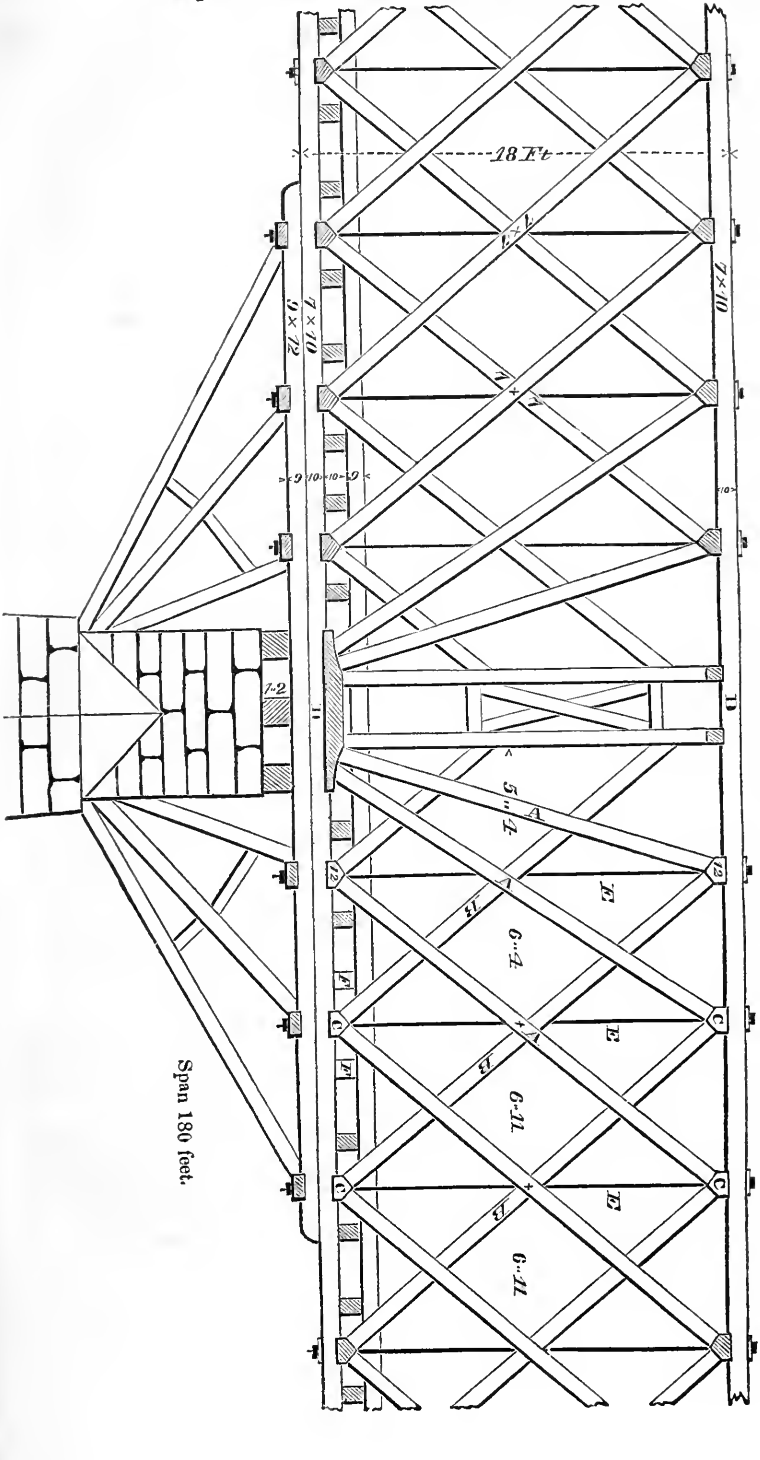
Each truss is formed of a system of *main braces*, A, A, A, seven inches square, of white pine, inclined from the piers towards the centre of the span, abutting upon *white oak shoulders*, C, C, C, which are let into the *chords* D, D, to a depth of two inches; and *counter braces* B, B, B, of the same dimensions, inclined in the contrary direction, passing between each pair of *main braces* and also abutting upon the *white oak shoulders.* The upper and lower *chords* are composed of planks, forming, in all, six horizontal beams of seven by ten inches each. The whole truss is firmly bound together by the *iron rods* E, E, E, two inches in diameter, passing between the *main* and *counter* braces, and through the *white oak shoulders;* having screws cut on their lower ends, and the lengths adjusted by means of burrs; these suspending rods act in lieu of the king and queen posts usually employed, and sustain the lower chords, on which the girders, F, repose. The spans are 180 feet each, and the deflection of the bridge in the middle of a span, during the passage of a locomotive and train, by careful measurement, was found to be *only a quarter of an inch!*

* See the number of this Journal for October, 1841, page 250, where a brief abstract of the patent is given.



Section.

Plan.



Elevation.

Span 180 feet.

Some of the principal advantages of this plan are, that the stress comes upon the end grain of the *main* and *counter braces,* and is in the direction of their length—consequently there is not the same danger of the settling which occurs in lattice bridges, in consequence of the crushing of the pins and the splitting of the lattices at the ends—and there being a free circulation of air between the *main* and *counter braces,* the bridge is not so liable to the speedy decay which occurs in lattice bridges, wherever the lattices come in contact. There is also less timber required in Howe's truss than in Town's.

For a bridge of 180 feet span, there are in Howe's truss frames, 28,636 feet board measure.

For a bridge of 180 feet span, there are in Town's double lattice, 46,080 feet board measure.

These quantities of timber have been calculated for the trusses, or sustaining parts only, of the two plans respectively; supposing each to span 180 feet, and the truss depth of the former to be eighteen feet, whilst that of the latter was assumed at nineteen feet eight inches, both measured from the top of the upper to the bottom of the lower chord: the roof and floor would of course contain the same quantity of timber in both cases, and has therefore not been included, being evidently unnecessary in a *mere comparative estimate of the amount of lumber in each;* we must, however, observe that the above described trusses upon Howe's plan, contain the subjoined quantity of iron,—a material not used in the lattice bridges—viz:

Approximate weight of iron in the suspending rods and burrs of the two trusses of one of Howe's bridges, of 180 feet span,	21,100lbs.
Approximate weight of iron in the transverse top ties,	710
Total,	21,810

Or nearly, *nine and three-quarter tons of wrought iron.*

The usual cost of the superstructure of covered railroad bridges, upon the plan above described, with long spans, and for a single track railway, inclusive of all materials, and of the workmanship, is about $22 per lineal foot of floor.

In conclusion, the writer will add his conviction, that in bridges with spans equal to, or exceeding, those of the bridge at Springfield, the peculiar truss above described, will be found superior in strength, stiffness, and durability, to those of Town's double lattice plan.

Philadelphia, April 6th, 1842.

Use of Bituminous Cements in Europe, and in the United States.

Some time since, a document came to the Institute, under the frank of the Department of War, and for which we presume, we are indebted to the kindness of Col. Totten, Chief of the U. S. Engineers.

This document is entitled "Papers on practical Engineering, published by the Engineer Department, for the use of the officers of the United States corps of Engineers," and consists of a valuable essay on "Bitumen, its varieties, properties, and uses. Compiled from various sources by Lieut. H. W. Halleck, U. S. Engineer, under the direction of Col. J. S. Totten, Chief Engineer."

We extract from this essay the last chapter, (XII) which exhibits in an abbreviated form, some of the most important results of the experience which has now been had in the use of Bituminous mastics, both in Europe and in this country; it was our first design to have given a synopsis of the entire document, but on perusing it, we found that the chapter referred to, contained such a summary of the practice detailed in the body of the work, as in a great degree to supersede the necessity of any other condensation of the subject matter.

To this extract we shall subjoin some remarks upon Coyle's resinous cement, its properties, and cost, as developed in an experiment, made with it on a tolerably large scale, in forming a floor over the arch of the Licking Aqueduct on the Chesapeake and Ohio Canal, to prevent filtrations.

This cement, which is a factitious mastic, having for its basis the common rosin of commerce,—was here applied by Mr. Coyle, the patentee,* in person, under the general supervision of one of the Collaborators for the Engineering department of this Journal.

Extract from "Papers on Practical Engineering," published by the United States Engineer Department.

Cost, specific gravity, proportions of ingredients, &c., of the Mastic used upon several Bituminous Works in Europe.

The proportions of the ingredients for bituminous mastic, as recommended by the authorities referred to in the preceding pages, are very far from being uniform. And this want of uniformity is not altogether

* The *exclusive* right of Mr. Coyle, to apply the resinous cement, in such situations as this, would certainly never stand the test of a forensic discussion; as may be inferred by examining an extract from his patent, in the number of this Journal for June, 1838, where the claim is expressly stated to be, "*the applying it* (in places, or vessels, *which contain water*) so highly heated as that it shall expel the moisture therefrom, so as effectually to adhere to pebbles, stones, wood, and other substances, with which it comes into contact."

Now as the Aqueduct referred to, did not *contain water* at the time of the application of the cement, it was not a case within the purview of Coyle's patent; neither was the use which was made of it at the Treasury building, as mentioned in the latter part of our extract.

due to the difference in the quality of the bitumens used, for the proportions are made to vary considerably, by different persons, where precisely the same materials are employed. Further experiments and analyses are necessary to form definite rules. And we can see no reason why rules may not be as readily determined for the mastics, as for the mortars and hydraulic cements, provided we resort to a chemical analysis of the materials, and a strict examination of the strength, hardness, elasticity, specific gravity, &c., of the resulting mastics. We here give a summary of the proportions of ingredients, cost of labor, and other data from several bituminous works, in hopes that they may serve as a basis for further investigations. The following analyses of several of the bituminous minerals, by M. P. Berthier,* may also be of use in comparing the results obtained from different mastics. It was noticed too late to be inserted in a more appropriate place.

Bitumen of Seyssel.—Of the bituminous minerals of Seyssel, there are three kinds. 1. A sandy mineral. 2. A very fusible calcareous mineral. 3. A calcareous mineral of difficult fusion.

The first of these melts in boiling water, and becomes detached from the stony matters to which it was adherent. It rises to the surface, or sticks to the sides of the vessel in brown lumps, or forms a transparent coating of a brownish red color. A rich specimen of it gave—

Bituminous oil, - - -	.086	Bitumen,	.106
Carbon, - - - - -	.020		
Quartzy grains, - - -	.690		
Calcareous grains, - - -	.204		
	1.000		

In the mass it is much less rich. When purified by hot water, this bitumen is called *la graisse.*

The second variety is at Seyssel called *asphaltum.* It may be pulverized and sifted, but the powder spontaneously forms into balls. The specimen analyzed contained .11 of bitumen, 5.89 of carbonate of lime, without clay, and quite pure. The mastic of Seyssel is prepared by mixing nine parts of this asphaltum with one of the mineral tar *(la graisse)* extracted from the sand.

The third variety is a compact limestone, in extremely thin, parallel beds. It consists of—

Bituminous matter, - - - -	.100
Argile, - - - - - - - -	.020
Sulphate of lime, - - - -	.012
Carbonate of lime, - - - - -	.868
	1.000

Bitumen of Belley.—This bituminous mineral is very similar to the preceding. It is found in several communes in very considerable quantities, near the surface of the ground. It is of a variable quality. A specimen yielded—

* Annales des Mines, tom. 13, liv. 3.

Carbonate of lime, - - - - -	.824
Carbonate of Magnesia, - -	.020
Sulphate of lime, - - - - -	.013
Argile, - - - - - -	.023
Bitumen, - - - - - -	.120
	1.000

Bitumen of Bastenne.—This bitumen flows out from several openings, or springs, mixed with water. An analysis of the solid variety gave:—

Oily matter, - - - - -	.200	Bitumen,	.237
Carbon, - - - - -	.037		
Fine quartzy sand, mixed with argile,	.763		
	1.000		

Bitumen of Cuba.—This is transported to Europe under the name of Mexican asphalt, or chapopote. It is a solid bitumen, which exists in abundance near Havana. It may be used with great advantage in paving. It consists of at least two different substances, the one soluble and the other insoluble in ether and the spirits of turpentine. It is the relative proportion of these two substances which imparts to the different bitumens their peculiar properties.

Bitumen of Monastier. (Haute Loire.)—This does not soften in the least in boiling water, and hence cannot be extracted, by any simple means, in large quantities. It contains—

Bituminous oil, - - - -	.070	Bitumen,	.105
Carbon, - - - - -	.035		
Water, - - - - -	.045		
Gas and vapors, - - - -	.040		
Quartz and mica, - - -	.600		
Ferruginous argile, - - - -	.210		
	1.000		

The bitumen of Haute Loire differs essentially from those of Seyssel and Bastenne, by its insolubility in boiling water, and its solubility in alcohol.

The following is the quantity of material per square yard of bituminous covering, as given in the "Manuel pour l'Application de l'Asphalte du Val-de-Travers."

For one square yard of bituminous mastic paving, at a thickness of $\frac{48}{100}$ of an inch, there will be required—

33.10 pounds of the asphaltic mastic.
18.39 pounds of fine gravel.
0.62 pounds of mineral tar.

Or the following proportions may be used:—

36.78 pounds of the asphaltic stone.
2.84 pounds of mineral tar.
18.39 pounds of fine gravel.

For one square yard of ordinary bituminous covering, at a thickness of $\frac{4}{10}$ of an inch, there will be required—

40.46 pounds of pure mastic.

For one square yard of stable paving of the bituminous mastic, at a thickness of $\frac{72}{100}$ of an inch, there will be required—

From 40.46 to 44.14 lbs. of the asphaltic stone.
36.78 pounds of gravel.
2.68 pounds of mineral tar.

Specific gravity of the mastic made from the asphaltic stone of the Val-de-Travers—

One cubic foot weighs, - - -	140.99	lbs.
One square yard, $\frac{4}{10}$ of an inch thick, -	41.62	"
One square foot, $\frac{1}{12}$ of an inch thick, -	1.10	"

The specific gravity of the mastic of Parc, is 140.72 pounds, per cubic foot, which differs but very little from the preceding.

This last mastic, at the manufactories, costs, $2.25 per 100 lbs.

A covering of this mastic, $\frac{4}{10}$ of an inch thick, costs $1.01 per square yard.

The weight of the different kinds of asphaltic coverings recommended in the manual of the Seyssel Company, is as follows:—

First: A square yard of the bituminous covering applied upon cloth, the surface being first spread over with gravel, and the whole resting on a bed of mortar of a mean thickness of one and a half inches:—

For the mastic, - - - - -	45.9	lbs.
" " bed, - - - - - -	110.3	"
Total,	156.2	"

Second: The mastic, cloth, and gravel, for one sq. yd.,	45.9	lbs.
The tile, $1\frac{2}{10}$ inches thick, the mortar included,	73.6	"
Total,	119.5	"

Third: The mastic, cloth, and gravel, per square yard,	45.9	lbs.
The tile, $\frac{8}{10}$ of an inch thick, laid dry,	55.1	"
Total,	101.0	"

Fourth: The mastic, cloth, and gravel, per square yard,	45.9	lbs.
The tile, $1\frac{2}{10}$ inches thick,	82.7	"
Total,	128.6	"

Fifth: The mastic, cloth, and gravel, per square yard,	44.1	lbs.
The tarred paper,	3.6	"
Total,	47.7	"

The manual of the Val-de-Travers Company gives four and a half or five per cent. as the proportion of mineral tar to be used for flag-

ging sidewalks, vestibules, &c.; and seven and a half or eight per cent. for paving stables, courts, and works of that character. If the mastic be used for stables, the gravel should be full one half the whole mass. Mixture given for McAdamized roads, one-third coal tar, one-third pulverized asphaltic stone, and one-third fine sand. For pointing wooden pavements, the mastic is composed of eighty-five or ninety parts of asphaltic stone, five of mineral tar, and five or ten of fine sand.

Captain André used, at New Brisack, for covering the planking of a draw-bridge, one part by weight, of Lobsann mastic, and seven parts by weight of mineral tar. Cost of this covering per square yard, \$0.12.

Another mixture used for the same purpose, one part of Lobsann mastic, one and a half part of mineral tar. Cost per square yard \$0.14.

Captain Chauvet used for pointing masonry at New Brisack a mixture of ten parts of Lobsann mastic, and nearly one part of mineral tar. The joints were $4\frac{72}{100}$ inches deep, and one-fifth of an inch wide. Cost of this pointing per foot running measure, \$0.3¾.

Major Tomassin used for pointing masonry, at New Brisack, six parts of Lobsann mastic to one part of mineral tar. The joints were but $\frac{59}{100}$ of an inch deep, and $\frac{74}{100}$ of an inch wide. Cost of this pointing, per foot, $18\frac{7}{100}$ cents.

For pointing and rough casting masonry at Schelestadt, Captain Duché used thirty parts of Lobsann mastic to one part of mineral tar. Cost of this, per square yard, \$0.77.

The same officer at Strasbourg, and for the same purpose, used two parts of Lobsann mastic, and one part of mineral tar.

For coating masonry, at Valenciennes, M. Huz used a mixture of—

220 pounds of bituminous mastic,
110 " of linseed oil,
6½ " of litharge,
26½ " of spirits of turpentine, and
6 cakes of Spanish white.

Cost of a covering of this mixture, per square yard, \$0.12.

M. le Blanc gives the following proportions for an artificial bituminous mastic:—

18 parts of pitch *(brai sec,)*
18 " mineral tar,
6 " slacked lime,
60 " sand,
30 " fine gravel.

If chalk be used, the following are the proportions:—

1 part of mineral tar,
1 " pitch,
7 " chalk,
2 " sand,

The cost of a covering of M. le Blanc's artificial bituminous mastic, $\frac{6}{10}$ of an inch thick, per square yard, is—

For materials, about - - - -	\$0.12½
For workmanship, - - - - - -	0.24
For fuel, utensils, &c., - - - - -	0.03½
Total cost,	\$0.40

M. Partiot gives the first cost of the ordinary pavements of Paris, per square yard, \$1.25.

First cost of bituminous pavements of Paris, per square yard, \$1.42.

First cost of paving blocks, six inches thick, composed of fragments of stone and bituminous mastic, per square yard, \$1.27.

First cost of a pavement of an artificial bituminous mastic, $\frac{6}{10}$ of an inch thick, built on a brick foundation laid in hydraulic mortar, per square yard, \$1.01.

First cost of a natural bituminous pavement, of the same thickness, and of the same kind of foundation, \$1.39.

First cost of granite paving, \$3.32.

First cost of Lava paving $2\frac{4}{10}$ inches thick, \$2.24.

The composition used in forming a floor in Assomption Barracks, Paris, for one square yard, half inch thick, was made of—

Sand, - - - -	21.33	pounds.
Mastic, - - - - -	39.24	"
Mineral tar, - - -	0.62	"

The composition used in covering casemates at Vincennes, for one square yard, half inch thick, was made of—

Sand, - - - -	21.19	pounds.
Mastic, - - - - -	38.88	"
Mineral tar, - - -	0.52	"

The amount of coal required as fuel, to prepare the mastic for covering one square yard, is estimated by M. Perrin, at 10.87 pounds, and the amount of labor $\frac{7}{100}$ of a day's work. He allows $\frac{1}{10}$ of the cost for the use of utensils, and profit of contractors.

The proportions given in the manual of the Seyssel company for forming a mastic to be used on the caps of arches are:—

Powdered asphaltic stone, - - -	92 parts.
Mineral tar, - - - - - - -	8 "

If the mastic is to be used for roofs:—

Powdered asphaltic stone, - - -	93 parts.
Mineral tar, - - - - - - -	7 "

If it is to be used for flagging:—

Powdered asphaltic stone, - - -	60 parts.
Mineral tar, - - - - - - -	7 "
Gravel, - - - - - - -	33 "

The following table of prices of Seyssel mastic is published by "Coignet & Cie., Paris. Rue du Bac, 83:"—

Area of from—	Covering for Sidewalks.			Covering for Terraces.			Foundations. Of Concrete.	Foundations. Of Brick.
1 to 2 sq. yds.	$3.17	pr. sq. yd.	At a thickness of 0.48 of an inch.	$3.49	pr. sq. yd.	At a thickness of 0.40 of an inch.		
1 to 3 "	2.14	"		2.46	"			
3 to 4 "	1.90	"		2.38	"			
4 to 5 "	1.66	"		1.98	"			
5 to 6 "	1.58	"		1.90	"		$0.48	$0.55
6 to 7 "	1.50	"		1.82	"			
7 to 8 "	1.42	"		1.74	"			
8 to 9 "	1.34	"		1.66	"			
9 to 10 "	1.26	"		1.58	"			
10 to 50 "	1.18	"		1.50	"			
50 to 200 "	1.10	"		1.42	"		0.39	0.48
200 to 500 "	1.02	"		1.34	"			
500 and above	0.94	"		1.26	"		0.31	0.39

Pointing of flagging, $0.18 per linear yard.
"Solins," 0.21 " "

Asphaltic stone, eight and a half francs ($1.59,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

Mineral tar, forty francs ($7.48,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

Asphaltic mastic, fifteen francs ($2.80,) per 100 kilm's. (220½ lbs.,) delivered at Marseilles.

The following prices (from "Essay on Bitumen," London, 1839) for constructing bituminous pavements, &c., in London and the immediate vicinity, are those given in the advertisements of the Bastenne company, in the year 1839.

PRICES.*

First.—For the Materials.

Pure mineral tar, - - -	$6.16 per cwt.
Mastic, - - - - - -	2.20 "

Second.—For the Construction of Works.

The Paving of Sidewalks.

From 50 to 100	square feet,	$0.27½	pr. sq. foot.
" 100 to 250	"	0.24	"
" 250 to 500	"	0.20	"
" 500 to 750	"	0.18	"
" 750 to 1000	"	0.16	"
" 1000 to 2000	"	0.14	"
" 2000 to 5000	"	0.12	"

* In changing the denomination of these prices from the English to our own coins, the shilling is taken at twenty-two cents, its usual current value in the United States.

Covering of Roofs and Terraces.

From 50 to 100	square feet,	$0.32	pr. sq. foot.
" 100 to 250	"	0.29	"
" 250 to 500	"	0.23	"
" 500 to 750	"	0.22	"
" 750 to 1000	"	0.20	"
" 1000 to 2000	"	0.18	"
" 2000 to 5000	"	0.16	"

Pointing.

For filling up joints of brick-work, &c., the price will vary from one and four-fifths cents to two and one-fifth cents per foot, running measure, according to the quantity of mastic used.

These prices are calculated for a thickness of half an inch.

The following from Silliman's Journal—(Vol. xxxiv, No. 2,) are the retail prices, as charged by the Seyssel Company in Paris, for furnishing the raw materials, or executing bituminous works:—

Asphaltic stone in its native state,	$2.08	per 100 lb.
For constructing foot pavements, &c., &c.,	1.28	per sq. yd.
For covering roofs, &c.,	1.65	"

From the same work we find the following prices: For Yorkshire stone paving, where small sized flagging stones were used—

	Tooled.	Rubbed.
For three inch paving, per square foot,	$0.16	$0.21
For four inch paving, per square foot,	0.22	0.26

Where larger stones are required, for the more traveled thoroughfares, the prices are as follows:—

	Tooled.	Rubbed.
For four inch stone, per square foot,	$0.36	$0.44
For five inch stone,	0.44	0.52
For six inch stone,	0.62	0.70

The "Civil Engineer's and Architect's Journal," page 419, gives the Belgium prices for making sidewalks of Lobsann mastic, as follows:—

Any area under 30 yards,	$1.02	per yd.	for plain work.
	1.09	"	lozenged.
Any other quantity,	0.95	"	for plain work.
	1.02	"	lozenged.

Use of Bituminous Mastic in the United States.

Although we have several varieties of bitumen in different parts of this country, and in some localities large quantities of it, but little attention has heretofore been given to its use; and even in the few instances in which it has been employed as a building material, no proper record of the details and results has been made or published. Considerable quantities of the foreign bitumens have been imported and used in our large cities for sidewalks, floors, roofs, &c., but they have sometimes failed to give satisfaction, through ignorance of the

proper mode of making and applying the mastic. Wherever the proper directions have been followed, the success has been complete. It is hoped that the experiments which are now being made upon our public works, will soon furnish some valuable facts to be added to the following scanty record.

Major John L. Smith, of the United States Corps of Engineers, procured for the public works in New York, in the fall of 1839—

Asphaltic stone at - - -	$ 1.13	per 100 lbs.
Bastenne tar, - - -	4.76	"
Use of kettles and other utensils, -	0.30	per day.
Services of an "applicateur," -	1.50	"

The same officer purchased in New York, from the agents of the Val-de-Travers Asphaltic Company—

Asphaltic stone at - - -	$ 1.20	per 100 lbs.
Bastenne tar, - - - -	5.25	"

In March, 1841, in consequence of the above company stopping operations,* Major Smith purchased of the agents in New York, Messrs. Thirion & Millard, their whole stock of Bastenne tar, consisting of twenty-nine casks, each containing about six hundred pounds, at the reduced price of $ 3.93 per one hundred pounds; and the requisite amount of asphaltic stone to be used with this tar in forming mastic, at $0.90 per one hundred pounds. The remainder of their stock of asphaltic stone, for which they had no mineral tar, was offered at $ 0.81 per hundred pounds.

The "applicateur" employed at Fort Schuyler recommended that the above materials be used in the proportion of *thirteen* pounds of the asphaltic stone to *one* pound of the mineral tar. In one of the experiments made at that fort, the mastic was formed of 11½ pounds of the stone to one of tar. These proportions differ but slightly from those given in the manual of the Val-de-Travers Company for making mastic of the same materials. The experiments of Major Smith were completely successful. The casemates that have been covered with the mastic remain perfectly water-tight, and to this date no alteration can be perceived in the material.

An analysis of the cost of this covering gives, for one square yard—

53.70 pounds bituminous stone, at 1¼ cents per pound,	$0.67.125
4.70 pounds Bastenne tar, at 5¼ cents per pound,	0.24.675
Labor, fuel, use of utensils, &c.,	0.19.230
Total cost per square yard,	$ 1.11.030

In a letter to Major Smith, dated New York, September 2d, 1840, Mr. John Barrell, agent for the London Bastenne Company, offered

* The report of the company stopping operations was communicated to the Engineer Department, in a letter of Major Smith to the Chief Engineer, dated New York, February 16th, 1841; but in a letter which has been received at this department, dated Paris, February 24th, 1841, "Aug'te Baboneau & Comp'ie, Proprietaires des Mines d'Asphalte, du Val-de-Travers, (Suisse,)" offer to supply, in New York, any amount of the mineral tar and asphaltic stone.

to furnish that mastic, properly prepared for laying, at about one and a half cents per pound, independent of freight.

In September, 1839, one hundred and twenty-six square yards of "asphalte" (bituminous mastic) was laid by Mr. Caylers, agent for the Val-de-Travers Company, upon the stone paving of the upper terre-plein of Castle Williams, New York, at $ 1.25 per square yard. Upon a recent examination of this covering, it was found to be soft and brittle, and had no adhesion to the paving stones.

In June, 1840, Mr. Lowitz offered to lay, in the public buildings at Washington, pavements of the natural asphaltic composition for twenty-five cents per square foot, or to make a pavement three-fourths of an inch thick, partly of "natural asphalte," and partly of an artificial mastic, ("mastic cement,") for twenty-two cents per square foot. The application of this mastic as a covering to the Exchange in New York, is said not to have succeeded well. The following proportions for the ingredients of this "mastic cement" of Mr. Lowitz, were furnished to the compiler by Mr. Mills, the architect of the public buildings in Washington:—

	100 lbs. of asphaltic stone,	No limestone being used.
	10 lbs. of mineral tar,	
	50 lbs. of sand,	
Total,	160 lbs.	

The following is the proportion of the ingredients taken for five hundred and fifty square feet of bituminous mastic laid down at White Hall, in London:—

0.25	ton of	bituminous matter,
0.75	"	limestone *(calcaire,)*
0.50	"	gravel,

Total, 1.50 tons for an area of five hundred and fifty square feet, one half inch thick. From this it appears that one square foot of this paving requires one pound of the asphaltic stone, and about six pounds of limestone and gravel, making in all seven pounds. From these prices, Mr. Mills estimates the cost of the same mastic in Washington:—

One pound of the bituminous matter, duty free, - -	$ 0.05½
Six pounds of limestone and gravel, - - - - -	0.00½
Preparing and laying the mastic, - - - - - -	0.05
Total cost per square foot, - - - - - -	0.11
" " " yard, - - - - - -	0.99

Mr. Mills also gives the cost of furnishing and laying a marble flagging in the public buildings in Washington, per square foot, $ 0.62½
Ditto of Seneca stone, - - - - - - - - - 1.00
Ditto of German stone, - - - - - - - - 0.37½

Mr. Saltonstall, agent of the Bastenne Company, proposed to pave, with that bituminous mastic, an area of twenty-three thousand feet, in the new Treasury and Patent Office buildings, at fifteen cents per square foot. The agent in Philadelphia, of the Seyssel Company, pro-

posed to execute the same work for twenty-five cents per square foot of covering, half an inch thick. No trials have, as yet, been made of either. Four hundred and seventy-two square feet of Lowitz mastic were laid down, about one year since, under the east steps of the Treasury building, which has stood perfectly well. A few feet were at the same time laid upon the lower terrace, where it is exposed to the heat of the summer's sun and the frost of winter; it also has undergone no change. A covering of Coyle's artificial resinous cement was also laid both without doors and within. In both cases it has already been cracked and otherwise injured by the frost.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Coyle's Resinous Cement above referred to. By Ellwood Morris, C. E., *one of the Collaborators for the department of Civil Engineering.*

This cement is *a resinous mastic*, consisting of various proportions of dry clay in powder, compounded with the common rosin of commerce, by melting the latter in a caldron; and stirring in the powdered clay, whilst the rosin is kept in a fluid state by heat.

In 1838, Thomas C. Coyle, the patentee of this mastic, which he called the *American Cement*, published a small pamphlet filled with favourable certificates, from gentlemen who had inspected his specimens; and to one of these, which he presented to the writer, was appended a printed sheet, giving directions concerning the manufacture and application of the cement; which we re-print, as being necessary to a full understanding of the subject.

Brief Directions for preparing the materials, and for making and applying the American Cement.

"Select a piece of ground composed of good brick, or potters', clay; remove the soil by means of a plough; plough up the clay, and harrow the same; toss and handle it until it is completely dry. The dried clay is now pulverized by passing through a cylindrical mill, made of wooden rollers, similar in construction to a rolling, or sugar-cane, mill, with this exception, that the rollers are placed alongside of each other, instead of one above the other. A hopper is placed above the rollers for the convenience of feeding the mill. Beneath these rollers is placed a *wire screen*, in an inclined position, and by means of a small crank gives it a quivering motion; the clay dust will thus deposite itself beneath the screen, while pieces of stone, &c. &c., will be carried off down the inclined screen.

"*For making the Cement.*—Take from one to ten iron kettles (as the job may warrant) containing from ninety to one hundred and twenty gallons each, walled up in the same way that hatters' kettles generally are, or let the kettles be cast, and each set in a furnace sufficiently large to receive fuel enough to boil the cement, and placed

* Mr. Mills' manuscript letter to the compiler, dated July, 1841.

upon truck wheels; this will be found very convenient in executing small jobs of work. Take rosin of a good quality, and put into each kettle a quantity so as to fill, when melted, about one-fourth of each kettle. When the rosin is completely melted, commence adding the pulverized clay in such quantities as can be promptly incorporated with the rosin; a great boiling, or effervescence, takes place at the union, and almost entirely ceases when the union is complete. A brisk fire should be kept up until the cement begins to emit bluish smoke, which is the surest test that all vegetable matter is boiled away, and the cement ready for application. During the whole time, the cement should be kept stirred by the following means: Let a stirrer be placed in each kettle, with arms crossing at right angles; between these arms let it be interwoven with hoop iron, and a crank attached to the stirrer.*

"*Application.*—The cement is removed from the kettles by means of iron dippers attached to handles four or five feet long, or let the kettles be cast with a tube to project about one foot, and of sufficient size to admit of the cement passing out into tubs, or buckets, and carried to the place of application. It would be utterly impossible to lay down any general rule for the application of the cement that would embrace a great many of the jobs; this must be regulated by the good sense of the practical mechanic, according to circumstances. The following, however, have the inventor's experience to test their utility. When a vessel, wall, or pier of any kind, is about to be formed, let a frame be made of stout planks the size of the vessel intended to be built. It is a general rule to cast the bottom of all vessels first, then start the frame for the upright walls; let the frame be well braced from each side, so that the pressure of the cement may not cause it to spring or warp, then pour in the cement in its fluid state till the space be filled. When the cement becomes hard, the frame can be taken away. To prevent the cement from adhering to the planks, let paper, or some other substance, be spread over the planks; by this means the frame can be removed with ease and despatch. In building the wall of a fort, lock of a canal, or any work of magnitude, either to keep water in or out, if the work is required to be exceedingly strong, pack your stones loosely; raise your wall—say three feet at a time; place at the distance of four or six feet apart, iron or wooden pipes; pour your cement through these pipes; by this process the cement passes through the interstices till it gains its level on the top, filling with accuracy every part. While the cement is yet hot, the pipes or tubes must be removed, and when the cement becomes hard, let the walls be continued by the same process until they are raised to the extent required. This process could be proved on a small scale to the satisfaction of the most sceptical, by filling a barrel, or any other vessel, with stones, and grouting the same with the cement, then breaking the mass into fragments. It will bear sufficient testimony to the mind of what can be done on a larger scale."

* The kettles can be worked by manual labor or horse power, according to the magnitude of the job.

Mr. Coyle's patent bears the date of August 18, 1837; and the claim in substance is for *the application* of this mastic, "*in places or vessels which contain water.*" The composition itself was not claimed, having been long known, though but little used.

In the year 1838, a large body of this cement was applied to form a floor within the Licking Aqueduct of the Chesapeake and Ohio Canal; with the view of obviating those filtrations, which so commonly produce a dripping soffit, in the stone arches of canal aqueducts.

With regard to its use in this case, the following information was derived, by the writer, from personal inspection, and the official reports of his assistant in charge of the work.

The floor referred to, was formed by a mass three feet in depth, of angular fragments of limestone, of the size of a man's head, grouted full of the resinous cement, melted and poured in hot; side walls, several inches thick, were then formed of the cement alone, rising about a foot on each side, to cover the rubble work, and join the cut stone ashlar facing of the aqueduct trunk; and the expense of the whole, including Mr. Coyle's superintendence and all other charges, as stated in his bill, amounted to a little over $ 2,000.

The aqueduct arch has a span of ninety feet—the width of the trunk occupied by the rubble stone cemented floor, is $17\frac{95}{100}$ feet—the mean length of the same is $95\frac{4}{10}$ feet—and in consequence of the extrados of the arch occupying a small space, there were 152 perches of rubble stone used, each perch containing twenty-five cubic feet.

The total quantity of the resinous cement used at the aqueduct, was 2,720 bushels, of which 680 were manufactured in Baltimore, and brought to the work in fragments barreled up; the remaining 2,040 bushels were made on the margin of Licking creek, using the clay found on the left bank near the site of the aqueduct; the rosin alone for this portion was brought up from Baltimore, and the 2,040 bushels, consisted of 1,548 bushels of dry clay in powder, commingled with 492 bushels of rosin, or *three and one-seventh parts of clay by measure, to one part of rosin*—this was the general average, though in a great deal of it, the clay was incorporated with the rosin, in the proportion of *two and six-tenths part to one.*

The specific gravity of this mastic as made here was 1,886, and the weight of the cubic foot $117\frac{7}{8}$ lbs. Of the 2,040 bushels of cement manufactured at the aqueduct,

The actual cost—of digging, delivering, and preparing the clay—of the rosin delivered—and of the whole application of the cement—supposing the work prepared to receive it,—the kettles set up ready for use—and exclusive of any charges for superintendence, or for the use of the patent—was as follows:

164 barrels of rosin in Baltimore - -	at 125c	\$ 205.00
164 do do transported to the work, over 62 miles of railroad, and 44 miles of turnpike, = 106 miles, aggregate haul,	at 168c	275.52
Labor. { 141 days work of men,	at $131\frac{1}{4}$c	185.06
Labor. { 16 do of carts,	at $156\frac{1}{4}$c	25.00
516 barrels of clay cost nothing,		0.00
Total *actual cost* of 680 barrels of mastic made,		\$ 690.58

Each barrel contained three bushels—therefore the cost of a barrel of the cement as made here, was $\frac{\$\,690\frac{58}{100}}{680}$ or 102 cents per barrel; and the cost per bushel was 34 cents.

Being used without any admixture of sand, which enters so largely into, and so much reduces the expense of, common hydraulic mortars, this mastic is very costly in its application: thus to grout the 152 perches of rubble stone, *loosely placed,* required 1,300 bushels, or $8\frac{55}{100}$ bushels per perch, *costing,* (at the ascertained price of 34 cents per bushel,) \$2.91 *per perch for the mastic alone.*

Some rough experiments which were made during the progress of this work, showed that Coyle's mastic contracted in cooling, about $\frac{1}{20}$th part of its bulk in the fluid state, and this aroused at the time, in the mind of the writer, strong doubts as to its resisting, with success, the changes of temperature incident to our climate; subsequent experience at this work and others, has shown that these doubts were well founded, and it may now be pronounced, that the dilatable and contractile properties of this cement, render it unfit for use in the open air, because it possesses but little ductility, and cracks to pieces under the effects of frost; another evidence of its deficient ductility, may be gathered from the fact that it admits, like stone, of being freely sledged into fragments: the writer also noticed that in hot weather—when the sun's rays reflected from the cut stone walls of the aqueduct trunk, rendered it an unusually warm position—prints of the footsteps of persons, passing over the mastic, remained upon its surface.

The patentee states in his pamphlet, in speaking of this cement, that "its imperviousness has been tested, by subjecting a plate of it, one-fourth of an inch thick, to the pressure of a column of water *twenty feet high,* without affecting it in the least." And the writer, from what he has seen, entertains no doubt that when in sufficient mass, and free from cracks, *it is* impenetrable to water; if then it were used in situations which admitted of its being protected from great atmospheric changes, by a covering of earth, or other means; it seems highly

probable that there are cases in construction, where it may be made very useful in preventing filtrations.

The cement under consideration is very adhesive both to stone and wood, if they are clean and free from dust, of which the interposition of but a small film appears to be sufficient to impair, very essentially, its adherent properties.

The writer having noticed that when the cement was brought from the caldrons and poured upon the cold rubble stone, it very quickly became viscid and ceased to run, conceived the idea that its penetration into a mass of fragments of stone would be very limited in depth; and upon mentioning this to Mr. Coyle, that gentleman (with a readiness to make experiments to satisfy objections, which always distinguished him,) immediately caused a hogshead, four feet in height, to be filled with stone, and then grouted up with the resinous cement; at a subsequent period the hoops were knocked off, and the staves being removed, the cemented mass was sledged up, (splitting indifferently through both stone and cement, like a homogeneous body,) and it showed *no cavities in any part:* this was accounted for by the fact that the body of stone was comparatively small and easily heated up—the shape of the vessel favorable to the retention of heat—and the material composing it a non-conductor; the writer then took up and examined a portion of the rubble stone floor which had been apparently grouted full—but numerous cavities were found at the depth of a foot and a half; which induced the subsequent carrying on of this work, *in layers of one foot deep.*

The net actual cost of the "American Cement" (clear of all profit) *being* $ 2.91 *per perch of* 25 *cubic feet of wall*, or nearly treble that of the calcareous cements generally used in hydraulic works, it is not at all likely that this mastic will supersede them in ordinary constructions, though situations will occasionally occur where it may be used with propriety, if the cost of the Bituminous mastics, or other circumstances, should prevent recourse being had to them.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Injudicious Policy pursued in the Construction and Machinery of many Railroads in the United States. By John C. Trautwine, *Civil Engineer.*

I have read, with much pleasure, an able pamphlet, entitled "*The causes which have conduced to the failure of many Railroads in the United States,*" written by Mr. Charles Ellet, Jr., Civil Engineer, of Philadelphia.

Mr. Ellet proves, in my opinion, most satisfactorily, that the cause

of so many failures in railroad enterprises in the United States, is not to be traced to any defect in the system itself, but to the injudicious application of the resources of the companies, to the accomplishment of the object to be effected.

There has been much more money expended on many of our railroads, than either their present or prospective resources could possibly justify. Even admitting that the anticipations of their warmest advocates, as to their probable amount of trade, had been fully realized, a little calculation would show that an expenditure altogether disproportionate even to *that* amount has been thoughtlessly lavished on many of our enterprises. Indeed they have, with, however, several honorable exceptions, been commenced, and carried on, with so little reference to the principle of adapting the means to the end, that it is only matter of surprise that so great a number of them sustain themselves even so well as they do.

This position is so amply supported by the numerous failures to realize the anticipated results that were to follow the construction of many of our railroads, as to need no labored arguments in its behalf. The fact speaks for itself more convincingly than any thing I could say on the subject; indeed, I am not certain that I should have ventured to enter my feeble protest against our present heedless system of railroad making, had I not been sustained by so incontrovertible an argument: for when the current of public opinion once sets strongly into a determined channel, no matter how ill directed its course may be, it is rarely that good results to him who ventures to stem it. It is only after the vessel, entrusted to its stream, has struck upon the rocks, that one may, without apprehension of censure, strive to save the fragments of the wreck, or mark out the dangerous spot upon the chart.

The chief cause of these failures has been, as Mr. Ellet remarks, our want of attention to first principles. We are too much an *imitative* people; and, in our endeavours to keep pace with England, whose vast pecuniary resources, and concentrated commerce, enable her safely to reduce to practice those abstract principles, the union of which constitutes the "beau ideal" of a railroad, we overlook the great disparity that exists in the trade and financial capacities of the two countries;—almost unlimited in the one, but comparatively restricted in the other.

The moment news reaches us of some important change in railroad policy adopted by the mother country, no matter what expense its application necessarily involves, our engineers are not content until they effect its introduction upon the several works under their charge.

Now there is certainly nothing culpable in this disposition to avail

ourselves of the experience of others;—on the contrary, where a *parity of considerations exists*, it is wise to follow the beaten track. But it is equally certain that a blind adoption of every abstract improvement—without regard to any existing disparity of means or of secondary causes calculated to neutralize its beneficial effects—may be justly deprecated.

The engineer, before he can decide properly on the details of his location, superstructure, machinery, &c., must ascertain as an essential element of his decisions, not only what is the probable *amount* and *nature* of the trade which the road will be required to accommodate, but whether or not it will present itself in such quantities, and at such intervals of time, as will admit of loading the engines nearly up to their full capacity of draft.

If the trade is so heavy as to require many engines, and so regular that nearly full loads may be depended on, he will of course find it advisable to encounter great expenses for light grades, heavy rails, and powerful engines; because, abstractly considered, a certain amount of power is much more economically maintained, and applied through the medium of one large engine than of two or more smaller ones; and the use of such powerful engines necessarily involves that of proportionally heavy rails and superstructures.

Again, still further to reduce the number of engines by enabling them to draw maximum loads, the grades, or acclivities of the road, must be reduced as much as possible.

A perfect railroad would be that on which the least imaginable force would draw the greatest imaginable load; such a road is evidently a theoretical one; it can never be attained in practice; but it is the duty of the engineer to approximate to it in every instance, as closely *as the trade of the road, and the interest of the company, will admit.*

It follows then, that the above considerations of grades, weight of engines, rails, &c., although not reducible to any one fixed rule for their application to practice, still have certain limits which we may not transcend with impunity. It is plain that every railroad, to some extent, constitutes a case by itself;—it requires its own peculiar calculations; and the engineer must modify, and remodify, his assumed outlays for gradients, curves, engines, rails, &c. until he attains that happy medium in each, and consistency in all, that will best subserve *the interests of the company. That* must be his guiding principle; and if he hopes in every case to attain that end, by simply making for them a railroad combining in itself all the improvements of the age, the chances are greatly in favor of his being disappointed.

It is not the *best railroad*, but the *best paying* railroad, that should

be aimed at; and the two are by no means necessarily associated in our country, except in comparatively few instances.

Experience has shown that we may assume the annual expense of running such engines as are now in common use on all our railroads, at about $5,000 each; and as $5,000 is the interest at 6 per cent. on $83,333, we see that the engineer may very properly incur considerable expense in diminishing the number of engines requisite for maintaining the traffic of the road. But it happens on many of our railroads that the number of engines employed, is less dependent on the grades, or even on the amount of transportation, than on the *number of trips* which the nature of the business requires to be made daily. This business may be so great as to yield a fine revenue, and yet not of such a nature as to require either high grades, heavy rails, or powerful engines; but on the contrary, such that if grades, rails, and engines of this kind be provided for it, the result must inevitably be a failure of the enterprise.

Such are the cases that constitute the numerous railroad failures in the United States. Nothing but the want of knowledge of, and attention to, the principles that influence the expenditures warrantable in each instance for the attainment of light grades, easy curves, and heavy superstructure, has led to so general a disappointment among railroad adventurers, and excited sentiments of distrust with regard to the system itself. Indeed no argument could probably be adduced, so favorable to the merits of the railroad cause, as that it has survived the horrible manglings inflicted on it ignorantly by its best friends. It has struggled through a long and well fought contest against both friends and foes; and now stands forth in its might, victorious, though wounded almost to the death.

The grounds of every expenditure on a railroad should be, that the annual saving thereby induced, shall more than counterbalance the interest on the increased cost. To this test, not only the general character of the line, but every deep-cut tunnel, bridge, and other important work along it should be submitted, before it is finally decided on; and this cannot be done, unless the engineer is previously in possession of some general data, as to the amount, nature, and regularity of the anticipated trade of the road.

It is upon this principle that the enormous original outlays on the English railroads are so willingly encountered. The English engineer first ascertains that the transportation will not only justify a first rate road; but that in order to accommodate it, with a due regard to economy, the road *must* be a first rate one.

But our American engineers, *as a class,* do not descend to first principles. It is enough for them, that such and such improvements

have been introduced in England;—omitting all considerations of the premises, they look only to the conclusions; and the imitative faculties are forthwith called into requisition, without any regard to the modifying, and controlling circumstances peculiar to their own case. They dash on blindly in their operations, deluded by the impression that they cannot err, if they only adhere closely to their English copies. Deep cuts, high embankments, heavy rails, powerful engines, long tunnels, expensive masonry, &c. &c. are all decided on, as matters of course, whenever an opportunity offers, without a moment's reflection that the interest on their cost may never be repaid by their services—but that, on the contrary, they must for ever operate as drains on the annual revenues of the company.

Yet with the data of probable amount and nature of the trade, together with the expenses of transportation as now developed by experience, the adoption or rejection of all these things admit of an easy determination. But unfortunately it is easier to point towards England, than to make calculations even of the most simple character.

This servile imitation, or rather attempt to imitate the splendid practice of the English engineers, without either the motives, or the means for carrying it out, has been the source of incalculable injury to the railroad cause in the United States. All would be well, were we content to investigate the *principles* upon which their practice is founded; for by adhering to those principles, we should, (as would they also in our circumstances,) arrive at a system of construction entirely different from that which their unlimited trade, and equally unlimited finances, now warrant them to adopt. The same *principles*, lead to *totally different practice*, in different circumstances.

Having ascertained, approximately, the probable amount and nature of the trade which the road will be required to accommodate, and knowing pretty nearly the rates of carriage it will bear, we arrive at a sum which constitutes the gross annual receipts of the road. If from this amount we deduct a portion sufficient to defray the annual expenses, we have the yearly profits. These profits are the interest on the principal which we will be justifiable in expending on the construction and furnishing of the road.

Self evident as the propriety of this simple precautionary process of calculation is, and impossible as it would appear to be, (and actually is,) to decide properly on the character of the contemplated road, and its machinery, without it, yet it has not probably been resorted to by the engineers of one road in ten that has been constructed in the Union. When the engineer commences his location, his aim almost invariably is, to obtain the *best* abstract line; and whether his road is to obtain 5,000, or 50,000 tons annually, the character of his

grades, curves, superstructure, machinery, &c., will be precisely the same. His standard of propriety is an invariable one; it adapts itself to no contingencies; it admits of no accommodation to difference of objects to be effected. It is summed up in the brief sentence, "the English do so."

The usual routine is pretty much after this manner, viz: the survey is made; the map drawn ; and the grades and curves laid down *without any reference to the object or cost of the road ;*—then the calculations of cost are made ;—and finally, to make both ends meet, an exhibit of probable revenue is concocted, *to suit the Report!*

The road is made; it does not pay ; the railroad system "won't do." I do not mean to insinuate that this mode of proceeding is resorted to with the intention to deceive; but that it does deceive, and that ruinously, is undeniable. We are apt to be led astray by our prejudices in favor of any project in which we are personally interested. Every engineer considers his road to be a little more important than any other in the world; and under the influence of such feelings, imaginary freight flows to it, from all quarters, without limit. Like the Legislator's conscience, it is "equal to any emergency ;" and it is unfortunate that it is so. Were it otherwise, reports and profits would coincide much more nearly. Now, most of our railroads that have failed to pay well, have been constructed principally for the purpose of accommodating, from two to four times a-day, the passengers, baggage, and freight brought to them either by some other connecting line of railroad, or by stages, or steamboats. But few, if any, of those connecting large cities may be considered as failures. I hope to show that to conduct such a business as that represented in the first case, does not, as is generally supposed (and practiced on) necessarily involve a company in enormous expenses, for easy grades, powerful engines, and heavy rails. In attempting this, I shall, for the sake of illustration, suppose a case, and carry it through.

The amount thus to be transported, say only twice a day (once in each direction) may, generally speaking, be carried by a single light engine, weighing, with her complement of fuel and water, not more than six tons, over grades as high as sixty feet to a mile, by merely slacking her speed at such points.

Let us suppose that an engine of this light weight, would take, over such grades, a gross weight of only thirty tons, exclusive of her tender; and let us see how much business one such trip daily, in each direction, would amount to in a year, of 300 working days. At first sight, this may appear to many of my readers, like taking a very contracted view of the subject; but before we conclude, it may, perhaps, assume a somewhat more imposing aspect. The six ton engine is

assumed merely to show how small a power can, on a railroad, satisfy a considerable business. In practice I should recommend, for such a superstructure as is hereafter described, eight ton engines.

Gross load of an engine weighing six tons, with her compliment of fuel and water in the boiler, but exclusive of her tender, over grades of sixty feet to a mile.

	Tons
40 passengers and their baggage,	4
Passenger cars, - - -	7
Freight, - - -	12
Freight cars, - - -	7
Total, - - -	30 tons, gross load.

Now if we suppose only one such trip daily in each direction, and assume 300 working days to the year, we have annually,

24,000 passengers.
7,200 tons freight.

Let our road be fifty miles long;—the charge for passengers $2.50;—and for freight $4 per ton. Then we have for the gross income of the road,

24,000 passengers, at $2.50,	$60,000
7,200 tons freight, at $4,	28,800
	$88,800 gross annual receipts.

And this, it will be remembered, may be accomplished by two engines, (one for each direction daily) so small in comparison to those which are now coming into favor for *all* roads, as to appear like models: and over grades of sixty feet to a mile, with an eight ton engine, an addition of about fifty per cent. might be made to the above amount of trade and income, with but a trifling increase of expense. But now let us see whether so small an income as $89,000 per annum, would justify the construction of a railroad fifty miles in length.

Experience has shown that the annual expenses of our railroads, generally range within from thirty to fifty per cent. of their income; varying, of course, with many circumstances, which it would not be to our purpose to expatiate on in this place. There can be little doubt that these expenses would be materially diminished on most of our roads, by the use of lighter engines and cars, lower rates of speed, and Kyanized timber for the superstructure; but, although our road contemplates all those conditions, still we shall assume fifty per cent. of the gross receipts, as necessary to defray the gross expenses.

If then from the $89,000 of gross income of our road, we deduct fifty per cent. (say $45,000,) for expenses, there remains the sum of

$44,000 of clear annual profit. Now $44,000 is the interest at eight per cent. on a capital of $550,000; which amount, and no more, we would be justifiable in expending in the construction, and equipment, of a railroad fifty miles in length, intended to accommodate so small a trade as we have assumed, in our example; and required to realize dividends of eight per cent. per annum.

If from this capital of $ 550,000, we set aside $ 50,000 to cover the expense of furnishing our road with engines, cars, water-stations, depots, &c., there still remains $ 500,000, for the construction of the road itself; which in this case, is equal to $ 10,000 per mile.

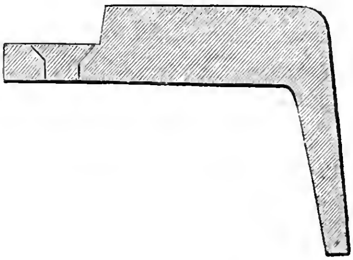
Here then it is evident, that if we wish "to keep up with the age," and to build a road of the best *abstract* character, our project must be abandoned; because the sum of perhaps from $ 20,000, to $ 30,000 per mile, would be required to construct such a one. And although we should even be convinced that at some future day, distant perhaps ten or twenty years, the road would, by the gradual accumulation of business, be able to realize profitable returns on this large investment, still adventurers could scarcely be found so confiding in these prospective advantages, as to embark their capital in it.

But in the case before us, I should certainly advise not to keep up with the age; but to go back to those ancient times, some five or six years past, when flat bar roads were in fashion; the old flat bar road, that has been so unmercifully crushed out of existence by our mammoth engines, of the present day. I entertain a high regard for the flat bar road; and conceive that the odium which is now attached to its memory, has not been justly incurred. Does it follow, as a matter of course, that because it is not adapted to very heavy trades, necessarily involving the use of powerful engines, and a resort to high velocities, that therefore it may not be very serviceable, nay, more serviceable than any other, in cases where the limited business admits of lighter engines, and does not justify the construction of a more expensive road? The outcry against the flat bar road, has, in my opinion, but little foundation in justice. It is, like our more permanent structures, good in its place; and its place is, where light engines, moving at moderate velocities, can satisfy all the demands of the trade at less expense, than heavy engines on the more permanent roads can do. And such cases are very numerous. The reader cannot, I presume, infer from this, that I should recommend to substitute the flat bar for the 75 lb. rail on the Liverpool and Manchester road; in that event, I should, beyond all controversy, be "behind the age;" but, by inversion, I conceive that any one who should advise to employ the 75 lb. rail, at its enormous expense, upon a road on which the cheap light bar would answer every purpose, would be equally open to censure.

However, we are digressing from our subject; let us see what kind of railroad we can construct for $ 10,000 per mile.

In the first place, I would limit the weight of the engines to the maximum of eight tons; and would allow no greater weight on any one engine or car, than one ton. The speed of passenger trains should not exceed twelve or fifteen miles per hour; nor that of freight trains seven or eight miles. The grading, it is needless to say, should be for a single track; the acclivities should coincide as nearly with the natural surface of the ground as the maximum would admit of, provided said maximum did not seriously interfere with the time of making the trip, or render assistant power necessary. Sudden changes of grade should of course be eased by vertical curves. But trifling expense should be incurred for horizontal curves of greater radius than about 1500 feet; and should any very serious object require it, I should admit of radii as short as 300 feet.

The superstructures if not piled,* should consist of log cross-ties, and of six by six inch strings, supporting a flat bar, or rather *flanched* bar, similar to that on the South Carolina railroad; but smaller, as shown in the figure, two thirds size.



Finally, the whole of the timber should be thoroughly Kyanized, or otherwise protected from decay.

Now, so far from expecting this superstructure to be knocked to pieces in a few years, as the old flat bar roads generally were, I should calculate on its annual repairs being less than on perhaps any railroad in the United States: and that, not from any inherent virtue in the road itself, but from the simple fact that *all its parts are fully proportioned to the offices they have to perform.* We should have no crushings or deflections here; but with its light engines, it would be one of the stiffest roads in the Union; and moreover, a much more agreeable one to ride on, than any of those of more permanent construction. Beside which, it would annually yield eight per cent. clear profit in its cost, when doing only the moderate business of one trip daily in each direction, with a small *model* engine, over grades of sixty feet per mile; or, should the business require the use of eight ton engines, it would yield twelve per cent. profit on the same number of trips: or should two trips daily in each direction be necessary with such loads, it would yield twenty-four per cent. profit.

* See my paper on Piled Superstructures, page 226.

Below is an estimate of its cost. If the professional reader should think the item of grading too low, (and it is, I suspect, the only one on which he will have any doubts) let him take the profile of almost any road in the United States, and relocate it, in imagination, so as to adapt it to sixty feet grades, and he will find the allowance to be ample.

Estimate per mile, single track, of such a Railroad as the foregoing.

Grading, culverts, drains, road-bridges, &c.,	$ 4,000
Fencing, (1400 panels at 50 cents, $700; but allowing fencing only half way,)	350
Land damages,	400
Cross-ties—1760, at 25 cents,	440
String timbers, 35 thousand feet board measure, at $ 25,	875
Iron flanched bar—24 tons, at $ 65,	1,560
Splicing plates,	30
Spikes,	100
Workmanship, 1760 lineal yards, at 50 cents,	880
Surveys, engineering, instruments, &c.,	800
Earle-izing, 13,000 cubic feet, at 2½ cents,	325
Incidentals,	220
Total,	$ 10,000

In northern climates, a small addition to this sum would be advisable for broken stone under the cross-ties.

Thus we see, that such a road as we speak of, can be constructed for the moderate sum of $ 10,000 per mile. Yet how many railroads are there in the United States, not enjoying even the limited business to which this road is adequate at two trips daily, on which not only thousands, but tens and hundreds of thousands have been thoughtlessly squandered for light grades, heavy rails, and powerful engines.

[TO BE CONTINUED.]

Facts and Observations on Four and Six Wheel Engines. By John Herapath, Esq.

[CONTINUED FROM PAGE 249.]

London and Birmingham Railway.—Conceiving, the only way I could possibly come to a right conclusion of the cause of any difference in the safety of the engines, was to travel upon them, I procured orders for permission to do so. These orders are absolutely necessary on some of the lines where the injunctions are most strict not to allow any one to go upon the engines. On the London and Birmingham it is as much as a man's place is worth to permit it.

By taking the engine, I was enabled to decide very easily respecting the sinuous motion which is indeed, upon any line in good order, the only sensible motion; for the pitching motion is obviously insensible if the road be good, the draughts steady, and the coupling link about upon a level, or not much above the axle of the driving wheels. The rolling motion, too, I have not yet been able to detect, unless the road was out of order.

My method of judging of the amount of sinuous motion was to fix myself firmly at the end of the engine, and observing how much a point on the front of the frame of the engine deviated to the right or left of the rail, taking as much care as I could to make the visual line fall at the same distance in all engines before the front axle. This is the best practical method I could think of, and though it might not be mathematically accurate, perhaps it would be much more easy to find fault with it than practically to find a better. By a little care one is able to decide pretty correctly in this way, of the difference of sinuous motion between two engines. For instance, if one appears to deviate two inches and another three, which a practised eye can appreciate very well, the one has half as much motion again as the other, and so on. I have thought of, and tried, other ways for the same object, but could find none so satisfactory as this simple plan.

The front rolling motion I have best detected by watching the motions of the front fire-box—not the motion of the chimney, for that is often loose and a bad guide—with regard to the road or rails, taking care, however, to distinguish between it and the sinuous motion. In the hind part of the engine it becomes sensible by leaning one's back or shoulder against the side of the fire-box. In a similar way is the pitching motion discovered, that is, by watching the lifts and depressions of the front of the smoke-box, and by leaning against the hind part of the fire-box. But a person with a sensitive foot, and accustomed to ride upon engines, will soon feel any pitching in the engine. Engines which appear to one standing on the platform to move very smoothly, when tested this way, that is, by leaning against the fire-box, will often develope the most unpleasant motions, and create very disagreeable sensations.

But besides the rolling, pitching, and sinuous motions, some engines have a shuffling motion on the platform from side to side, keeping time nearly with the beats of the pistons. It is made manifest by leaning against the side rails on the platform. Others again have the same shuffling motion in length, discoverable by the same method as the pitching, and distinguished from it by its quickness and regularity, and keeping time with the pistons.

Again, there is often a vertical roughness upon the platform, very different over the same ground on different engines, and a most treacherous guide it is to try an opinion upon; the causes of which I shall describe in my report.

Monday, November 15, I started from Camden Town station on No. 41, taking the morning mail train which was driven by a very intelligent man. This engine, a four wheel one, was one of Mr. Bury's make, and one which, from its being so high, some might call

top-heavy. Its motion, however, was very free from rolling or pitching, except in some few places where the road has suffered from the late bad weather. I could, indeed, perceive no sensible difference between the rolling or pitching motion of this engine, and that of any of the three six-wheel engines, I rode on the Saturday previous on the South Western Railway. The apparent sinuous motion was about two inches, except once or twice when it might have reached two and a half or three inches. This, reduced to the distance of the axles, would make a real sinuous motion of one to one and a half inch. In other respects the engine was very pleasant to ride on, and I understand is esteemed to be a very good one. I stopped at Tring, but when I arrived a Wolverton I very carefully gauged the inside bearing marks of the flanches, and found them to be four feet seven-ninth inches, the gauge of the rails being four feet eight and a half inches. The distance from the extremity of the fire-box to the middle of the hind axle is four and three-quarter feet, distance of the centres of the axles six feet, and total length of the body of the engine, including the fire-box, is fourteen and three-quarter feet. The driving wheels are five and a half feet diameter, the cylinder thirteen inches, and the stroke eighteen inches. I was informed that it consumed twelve cwt. of coke, on an average, between Camden Town and Wolverton, fifteen miles, or twenty-six and a quarter lbs. per mile, but these data we shall hereafter have more accurately. This engine runs up with the night mail and down with the morning mail every day, and has had, I was informed, no material repairs done to it for about eight months.

All the mail train engines are an inch greater in diameter in the cylinders than the engines of the other trains, though the driving-wheels appear to be nearly the same, that is five and a half feet. The coupling link appeared to be about two or three inches above the level of the driving-wheel axle.

This engine is fitted with a guard to clear the rails, and a ballast gauge; that is a bar hung upon a pin coming down a little distance from the inside of the fore wheel to within two or three inches of the level of the axle, on the top of which bar, in a notch, is supported a lever, which, when the bottom of the bar is struck by the ballast being too high, is released, and falling, sets a whistle off; thus telling the tale of the ballasters having neglected their orders as to the height of the ballast where the roads are repairing. This happened in our journey, and was obliged to be reported at head-quarters. Such is the attention to everything on this line which may engender accident.

At Tring I left this engine and waited for the next train, having been informed that all the engines are changed at Wolverton.

The engine I now got on was No. 50, a four-wheel engine, made by Benjamin Hick. Its length, from the end of the fire-box to the axle of the driving-wheels was four and a half feet, ten feet to the fore axle, and thirteen and a half feet the extreme length of the engine. The driving-wheels as before were five feet six inches, cylinders twelve inches, with eighteen inch stroke. This was a much lower engine than the former, and I suspected at first a more steady one, but on getting up its velocity I found it had considerably more sinu-

ous motion, which I suspect was chiefly on account of its flanches being only 4 feet 7.1 inches, to a gauge of 4 feet 8½ inches, and great play in its bearings. The coupling link was placed about the same as in No. 41.

The engine driver informed me that No. 50 consumed about fourteen cwt. of coke in the journey of fifty-one miles, or 30.7 lbs. per mile; but with a strong head wind often-times it made a difference of two or three cwt. more.

At Wolverton I got upon No. 54, another of Bury's engines. This in cylinder, stroke, height, and distance of axles, was nearly a counterpart of No. 41, but its extreme length is half a foot less, and the gauge of its flanches four feet 7.6 inches. It had, therefore, about three-tenths of an inch more play on the rails, and it appeared to me to be less steady than No. 41, and not so lively as No. 50, but steadier. The driver said it consumed a ton of coke in its journey between Wolverton and Birmingham, sixty miles, or about 37.3 lbs. per mile; but the accuracy of his statement I should doubt, as he appeared to be not well-informed. At Rugby I got inside, having traveled eighty-five miles outside in rather sharp and snowy weather upon three of the Company's engines.

I could get no information from the men of any peculiarities in the structure of any of these engines, that is, whether they worked expansively or not, but with all this I expect to be supplied by the Company's officers.

As far as I have yet seen, Bury's engines do not deserve the character given of them of being "top heavy." One thing, however, is to be said that the road, taken altogether, is in so good a state of repair as not to exhibit any imperfections, if they exist. Indeed the term "top heaviness" in a good road is unintelligible; it can be only in roads much out of order, and curves badly constructed, that it can have an existence. On the London and Birmingham line there is no expense spared to make and keep the road in a perfect state of repair, and with a few exceptions it is in excellent order.

But though I can at present see no foundation for the clamour raised against Mr. Bury's engines, I must confess I think they can and ought to be made more comfortable for the men. The platform, for instance, round the fire-box is open at the sides, and bitterly cold, while a very little expense would remedy the defect. Indeed, upon the South Western, Birmingham and Gloucester, and Liverpool and Manchester, engines, that I have ridden on, it is done, and I cannot see why it should not be on the London and Birmingham.

Another fault I have to find with the fitting-up of these engines is, that many of them have no "dashing," or "splashing," guards, over the front wheel. In wet weather the wheels for want of them throw the oxide of iron from the rails, dirt, and particles of ballast, over the engine and the men, in a most annoying degree. Nay, from the several sharp blows I have myself had in the face with these particles, I am inclined to think it is not without danger to the men's eyes, and may therefore deter them from keeping so good a look-out as they otherwise would. The force of this seems now to be seen, for as fast as the engines undergo repair they are provided with splashing guards.

While I am complaining I must also be permitted to prefer another complaint, namely, against the breaks on the tenders. On Mr. Bury's tenders lever breaks are used, upon the arm of which the men stand, over the side between the tender and engine, pressing it down with the weight of their bodies. Should their feet slip, destruction is almost inevitable. Indeed, upon one of these dangerous things a man lately lost his life on one of the lines, and that Company are now preparing what they call shoes for the handles. But if these breaks were fitted as they are upon the tenders of many lines, with a screw and handle, or wheel, all this danger would at once be avoided.

Mr. Bury will not, perhaps, thank me for telling him thus publicly of his faults, but I do it because it is the most effectual way to cure him of committing them again. Besides, to confess the truth quietly, I have a little mischievous inclination just now to grumble and pick holes where I can. It is exhilarating to an exhausted frame, a sort of unction to the bumps and bruises I have gotten in my long and fatiguing journey.

[The rest of this communication we have deferred, the information from the London and Birmingham Railway coming only just before Mr. Herapath's departure.] Railway Mag.

[To be continued.]

Progress of Practical & Theoretical Mechanics & Chemistry.

Remarks on Ships of Wood and Iron.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times, in Journals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavour to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of construction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connexion with each other, arises from an external and internal series of planking. 2nd. The plan used in her Majesty's dock yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together I conceive would be found to be a better method.) 3rd. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker-built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.

The advocates of iron have, I apprehend, by no means exaggerated the defects of ships of the common construction, in which the connexion of the timbers with each other is extremely imperfect, even in the best built merchant ships, and the safety of the largest vessels is dependent on the security of the fastenings of the butts of a four inch plank.

I consider these defects are so fatal, that no increase of strength or improvement in workmanship can more than palliate them in a greater or less degree, and I propose to abandon any reference to these vessels, and at once admit their inferiority to vessels constructed of iron, provided the latter are made of sufficient strength.

A large proportion however of the present enormous annual loss of merchant ships seems to have been sufficiently traced to defective methods of construction, and to the facility it affords in covering the defects of cheap ships; still the causes that tend to foster the continuance of the present system are subjects foreign to the tenor of these remarks; the fact that the rottenness of the timbers can be concealed from casual inspection, is sufficient for our purposes. It has been urged that unless spaces are provided between the timbers, for the accommodation of water from leaks, that it would rise in the vessel and spoil the cargo. This argument is founded on the assumed necessity of leaks, but it affords proof of their frequent occurrence in vessels of the usual construction.

The rapid destruction of timber by the united operations of wet, heat and filth, and the generation of foul air from these causes, will not be denied; and in addition to its weakness the rapid deterioration of the frame of the vessel, from the above causes, seems an equally fatal objection—though exceptions may occur owing either to care or accidental conditions.

The second system of ship building with timbers wedged up solid, has been in use for a considerable period for ships of war, and the success that has attended this plan has been amply proved by the accounts of the escape of different vessels, that have since its adoption been driven ashore and got off again, in many instances without injury, and in other cases damaged to such an extent as would have insured the total loss of vessels of the common construction; for instance, the *Pique* lost a large portion of her keel, and in some places the whole of the garboard strake, and a part of the floor timbers were ground away by the rocks of Newfoundland, and yet this frigate crossed the Atlantic without a rudder, under circumstances, it must be admitted, of some anxiety to the officers and crew.

For merchant ships I should propose to use the same weight of materials as are now employed, the outside planking would remain without alteration, but the quantity of wood in the ceiling would be added to the width of the timbers, and in case it was insufficient to fill up the spaces between the timbers, the depth of the latter must be lessened to make up the deficiency.

Under these circumstances the timbers would be about double the thickness of the outside planks, and being placed close together, a good means of connexion might be obtained by large dowells or coaks,

so as to produce a mutual dependence on each other, and so that any pressure on the outside would exert a more regular strain on every part. A vessel constructed on this principle would be an irregular cask, and when caulked inside and outside would float without planking; and by the addition of the latter, a frame of great stiffness, and equal strength and thickness in every part would be obtained, on which one side of every piece of wood used in its construction would be visible, and would allow an examination to be made of its state with great facility. The other sides of the wood would be preserved from wet as long as the fabric of the vessel remained sound, and the caulking was attended to. It is obvious that a greater inside width of seven or eight inches would be gained in these vesels, and no loss of space would accrue if it was occupied by battens to admit of water accommodation for the leakage, and the prevention of injury to the cargo from the escape, until at least the present advocates of the assumed necessity of leaks in ships, became convinced of the small prospect of their occurrence under common circumstances in vessels so constructed.

It is true no provision will afford security to vessels on rocks among breakers, but such situations afford the best test of the merits of different systems of ship building, by the time each vessel is found capable of resisting these effects.

Numerous cases will occur where life is dependent on the time the vessel holds together, but the partial saving of the cargo may be considered objectionable by ship owners, among whom the advantages of a total loss are well understood. Opinions on these points are of little value, we must wait for evidences from wrecks under different conditions.

The scantling proposed for merchant ships would, I apprehend, be not quite so heavy as that in use for ships of war of equal size; at the same time, it is probable that the strength of timbers placed close together, except that of the dockyark plan of timbers wedged up, to such an extent that a greater strength may be perhaps obtained at a smaller cost. Plans of this nature are obviously only suited for good workmanship and good materials; but it ought to suit, for less insurance premiums, whenever an inquiry on this subject is properly conducted, and explanations are afforded to insurers of such a nature, as shall be fully understood.

The third plan referred to, requires similar conditions of timber and workmanship, but it has not been extensively adopted. Ten or twelve series of inch planks were employed many years ago, in a 500 ton vessel built at Rochester, but I conceive three or four series of two and a half to four inch plank, according to the size of the vessel, would be found a more convenient method of construction.

Several of the Gravesend steamers of 150 feet in length have been built of three series of one and a half inch planks, and they have run for four or five years, and are now said to be as sound as when first constructed, such at least was the case with the Ruby, when opened for the purpose of lengthening the bow to increase her speed.

This method however requires further trial, especially at sea, before

any decisive opinion can be given on its comparative merit; it is favourable to soundness, as the necessity of sawing the wood into planks admits of the certain selection of good materials, and would afford great facility in seasoning timber properly. While the expense of selection would in some degree be lessened by the conversion of the rejected planks to inferior purposes, or by working it up in inferior or cheap craft, perhaps for river use. The increase of cost would not answer unless it was accompanied by a proportional increase of durability, and perhaps the general opinion would be in favour of the latter result, as a necessary consequence of the selection of good timber.

The launches used in the navy have for several years been made on Johns' plan, of two series of planks crossed diagonally, their weight is about three-fifths of the boats of the old construction, and their durability has been much increased. The Gravesend steamers are built with two similar series of crossed planks in lieu of timbers, covered with an outside planking in the common mode, the whole well fastened with copper. In large vessels perhaps a ceiling connected in the same manner might be deemed advisable: at the same time it seems probable that a greater strength would be obtained by a less quantity of timber in the third than in the second method of construction proposed. Clinker built, which belongs to this class, in which the principal strength depends on the planking instead of the timbers, seldom exceeds 100 tons in size, and are usually of a light scantling; their great durability is well ascertained, provided they are kept from the ground, in which case from the thinness of the single part of the planking, holes are easily knocked in their bottoms.

The introduction of these methods of constructing timber ships is not likely to be effected, except by the nearly total destruction of the present trade in ship building by the more general adoption of iron vessels, and the interests of humanity will cause the earliest occurrence of this result not to be regretted. Nothing perhaps but the severe pressure of iron competition will induce the present race of ship builders to turn their attention to the means whereby greater strength, security and durability may be given to wooden ships; eventually perhaps its greater strength for a given weight, and its greater elasticity may obtain a preference.

Prime cost undoubtedly will form a principal element in the approaching competition; at present iron vessels are often built too cheap, or in other words too slight; the error may be, and I believe has been remedied. Innumerable questions will arise relating to the elasticity, strength, and durability of wood, as well as its quality; and also in reference to the destructive action of salt water on iron, the strain on the rivets, &c. &c., which can only be answered by experience.

To a spirited competition between wood and iron I look for the improvement of vessels of both materials. Recently I have met with parties who being engaged simply as owners on the proposed construction of a steam boat, in consequence of the difficulty in the choice of wood or iron, have found it necessary to institute an inquiry re-

specting their relative merits in ship building; these parties but for the difficult of selection, would have gone on in the good old jog-trot way of supposing, that British ships of the old construction were perfect specimens of the art, and would have patiently submitted to the present rates of insurance, as founded on the average loss, deduced from defective ships. The spirit of inquiry once roused among owners of shipping, will I trust lead to results as yet scarcely anticipated.

It matters little to the country whether wood or iron eventually obtain the preference; if British oak is abandoned it will be only superseded by British iron, and the inhabitants of our land ought to be satisfied if the latter will uphold the character of the navy as well as the former has done.

At present I consider the question of relative superiority as undecided, and though disposed to admit the inferiority of timber vessels of the common construction, yet the advantages of iron may not exceed that due either to the methods of construction adopted in the navy, or in the Gravesend steam boats. The latter method is perhaps best adapted for small, and the former for large vessels. Moreover, we want the evidence likely to be afforded by the wreck of the largest iron steamers, for the formation of an opinion respecting their powers of endurance under the breakers of a rocky shore, or a sand bank.

In regard to the relative advantages of the two plans of ship building proposed for the merchant service, the method adopted in the navy has received the stamp of experience, and the evidence is conclusive in its favor. The 500 ton vessel built of planks before alluded to, was driven ashore in a heavy gale under Mount Batten, in Plymouth Sound, when loaded with ordnance stores, in company with ten or eleven other vessels, all of which became total wrecks; she afforded an almost solitary instance of a vessel saved, when ashore on that point, and she is reported to have rebounded from the rocks for a short time like a cask, until a hole was knocked in her bottom; after the gale she was got off, and was repaired at a moderate expense, and proceeded on her voyage to the East Indies.

I should also be inclined to the opinion that a greater strength will be obtained with a less quantity of materials, by means of several series of planks than by close timbers and outside planking, but the latter plan seems to afford greater facility for repairs. In conclusion, I would remark that it is my object to assert the possibility of the introduction of great improvements in the construction of vessels of wood, without any increase and perhaps at some reduction of cost, and I wish to induce parties engaged in ship building to advert to the fact, that the best portion of their business, the construction of steamers, is rapidly passing out of their hands, and that unless sailing vessels are rendered stronger, safer, and perhaps lighter, this portion of their trade may follow, as the establishments for building iron vessels are increased, or at least such a depreciation of prices may occur as will be equally ruinous to them.

At the same time I must acknowledge that great improvements in regard to strength have been necessary, and have been adopted in many of the larger steamers, in some instances perhaps to the full ex-

tent here advocated, at least in the engine room; similar principles might be adopted in the fore and after bodies with lighter timbers, and hence a less strain would be thrown upon the midship body in passing over heavy seas. It is their general adoption that I would urge, and I cannot but express my conviction that steam ships of the largest class yet made, may be constructed to bear the winter seas of the Atlantic, by a better disposition of the timbers employed in their construction. Y.

Civ. Eng. & Arch. Jour.

On the Extraction and Decolorization of Gelatine.

By J. C. Booth and M. H. Boye.

In a patent granted to S. G. Dordoy, of Surrey County, "for certain improvements in the manufacture of gelatine size and glue," (see London Journal for January 1842,) the patentee proposes the employment of chlorine, for bleaching the materials employed, previously to the extraction of the gelatine, in which respect the patent mainly differs from former attempts at bleaching by operating on the gelatinous fluid after its extraction.

"For every 100 lbs. of the animal substances, eight ounces of chlorate or chloride of lime, potash, soda, baryta, or other similar compounds are dissolved, or thoroughly mixed in, or with, two, or more, gallons of hot or cold water; four pounds of hydrochloric or other acids being added and stirred thoroughly. This mixture is to be poured into the vessel containing the water and animal substances, the materials being stirred continually while the mixture is added. The animal substances should be kept entirely covered with the water for twenty-four hours."

The above proportions are considered sufficient for thin skins, as of sheep, but for heavier pieces, such as those derived from oxen, calves, &c., two or three steepings will be requisite, each continued the same time, until the substances appear of a uniform, transparent whiteness. The substances are thoroughly washed in pure water at ordinary temperatures, and then water at 160° Fahr. is poured on, and the temperature maintained at 100° Fahr. from twelve to twenty-fours hours, when the gelatinous solution is strained off. Fresh supplies of water are successively added, each portion at a temperature of 20° higher than the preceding, until at last the water is boiled.

This patent, like many others, makes a sweeping claim "to cover all the ground," but it might be restricted to the use of chlorine or its compounds with oxygen for bleaching animal matters previous to the extraction of gelatine, and not subsequent to this process, which had been repeatedly tried. In the latter case it has been found that although the color of the gelatine may be improved, its binding quality is materially impaired; but there is every reason to believe that the coloring matters may be obviated by the application of bleaching previous to extracting gelatine, since it is the opinion of chemists that this substance is not ready formed in the animal matters employed. Since then the patent contains good principles, it may be well to enquire into some of its details.

As is too often the case with chemical patents, its descriptions are vague and incompatible with the definite laws of chemistry. Thus it is not immaterial whether we employ the same amount of acid (of what strength?) with the same quantity of chlorate of potassa, soda, lime, or baryta, or with the chlorides of the same bases. Probably the chloride of lime is the only compound that can be employed economically; and in this case, if, as the patentee directs, the acid, which is twice as much as necessary, be poured first into the solution of the chloride, a considerable amount of chlorous or bleaching material will be lost. It would be advisable either to dissolve the chloride in two or more gallons of cold water and then add the acid previously diluted with three or more gallons of water, or to add the clearly drawn off solution of chloride to the water over the animal substances, and then to add the acid diluted largely with water. In either case, a bleaching liquor will be obtained which will act more uniformly and for a greater length of time without being exhausted.

The successive extraction of gelatine by water at low and increasing temperatures is worthy of notice, although not novel, but in this case the later solutions should be employed for gelatine of decreasing qualities.

On the Preparation of Aluminous Mordants. By JAMES C. BOOTH and M. H. BOYE.

Whatever relates to improvements in dyeing and cloth printing being of high importance, we have thought it worth calling attention to the above subject from the appearance of two patents, the one taken out in England by R. Hervey, (Rep. Pat. Inv., December 1841,) and the other in this country, (Jour. Frank. Inst. March, 1842.) They are worthy of consideration from the comparative cheapness with which the aluminous mordants may be prepared.

The most important point is the formation of sulphate of alumina by the direct action of sulphuric acid upon clay which has been calcined in a reverberatory furnace. Supposing the process to be successful, as described by the patentee, it offers great advantages, since an abundance of clay comparatively free from iron may be obtained in many districts of country, and even a portion of that iron must be rendered insoluble by calcination. In one respect the sulphate of alumina may be more advantageously employed as a mordant or color-base than the sulphate of alumina and potassa (common alum) since a given weight of it will contain a larger proportion of color-base than the same weight of alum; but, on the other hand, crystalized alum is so uniform in composition, that in its employment we operate more definitely and certainly, according to given weights, while the sulphate of alumina is difficult to be brought to a crystaline state. It is, moreover, liable to form basic salts, so that we cannot know with certainty and readiness the exact amount of alumina present in a solution of the salts. For these reasons the patentee is in error in supposing that the sulphate of alumina is superior to alum for printing, dyeing, &c.

The sulphate of alumina may be more successfully employed in the manufacture of the acetate, by means of acetate of lime or lead, for by decomposing alum perfectly, it is requisite to add a sufficient quantity of acetate to precipitate the whole of the sulphuric acid, not only that combined with alumina but also with the potassa, so that a considerable amount of the acetate is employed to no useful purpose; whereas for every proportion of the sulphate of alumina alone that is decomposed by an acetate, an equivalent quantity of acetate of alumina is formed. The most economical method is to precipitate with *acetate of lime* as long as a precipitate is formed, and then to throw down the small balance of sulphuric acid by *acetate of lead.* The second method described in the English patent, of precipitating alumina by alkali, or its soluble carbonate, and then redissolving the alumina in acetic acid, may often be practised economically, but there is then some difficulty in obtaining a liquid of uniform strength.

The remarks which have been made apply to both the American and English patents, and particularly to the latter, which is more copious. Since each of the points claimed in the patents has been the subject of previous experiments and manufacture, it appears to us that it would be a difficult matter to sustain the combination since other simple methods of removing the iron may be resorted to.

On an Uniform System of Screw Threads—communicated to the Institution of Civil Engineers, 1841. *By* Joseph Whitworth, Esq., Assoc. Inst. C. E.

The screw threads which form the subject of this paper, are those of bolts and screws, used in fitting up steam engines and other machinery. Great inconvenience is found to arise from the variety of threads adopted by different manufacturers. The general provision for repairs is rendered at once expensive and imperfect. The difficulty of ascertaining the exact pitch of a particular thread, especially when it is not a submultiple of the common inch measure, occasions extreme embarrassment. This evil would be completely obviated by uniformity of system, the thread becoming constant for a given diameter. The same principle would supersede the costly variety of screwing apparatus, required in many establishments, and remove the confusion and delay occasioned thereby. It would also prevent the waste of bolts and nuts which is now unavoidable. The impulse and direction given to machinery during late years have tended to increase these evils, and must ultimately lead to a change of system.

Were an uniform system adopted for marine or locomotive engines, there can be no doubt that it would be extended to engines and machinery of almost every description. Peculiar threads will, of course, be always required for particular purposes; but in screws for general use in fitting up machinery, the advantage of uniformity would be paramount to every other consideration.

It does not appear that any combined effort has been hitherto made to attain this object. As yet there is no recognized standard. This

will not be a matter of surprise, when it is considered that any standard must be to a great extent arbitrary. It is impossible to deduce a *precise* rule from mechanical principles, or from any number of experiments. On the other hand, the nature of the case is such that mere approximation would be unimportant, absolute identity of thread being indispensable.

Messrs. Whitworth & Co. were led some years ago to alter the threads of their screwing tackle on this principle, in consequence of various objections urged against those they had previously adopted, and the result of the experiment has been abundantly satisfactory. An extensive collection was made of screw bolts from the principal workshops throughout England, and the average thread was carefully observed for different diameters. The $\frac{1}{4}$, $\frac{1}{2}$, $1\frac{1}{2}$ inches were particularly selected and taken as the fixed points of a scale by which the intermediate sizes were regulated. The only deviation made from the exact average was such as might be necessary to avoid the great inconvenience of small fractional parts in the number of threads to the inch. The scale was afterwards extended to six inches.

The pitches thus obtained for angular threads are shown in the following table:

Diameter in inches.	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$
Threads to the inch.	20	18	16	14	12	11	10	9	8	7	7
Diameter in inches.	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$
Threads to the inch.	6	6	5	5	$4\frac{1}{2}$	$4\frac{1}{2}$	4	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$
Diameter in inches.	$3\frac{1}{2}$	$3\frac{3}{4}$	4	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6
Threads to the inch.	$3\frac{1}{4}$	3	3	$2\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{5}{8}$	$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{1}{2}$

It will be observed that above one inch diameter the same pitch is used for two sizes. This could not have been avoided without introducing small fractional parts. The economy of screwing apparatus was also promoted by repetition of the thread. Lon. Mec. Mag. Oct. 1841.

On a Voltaic Process for Etching Daguerreotype Plates. By W. R. Grove, Esq., M. A., F. R. S., *Professor of Experimental Philosophy in the London Institution.**

Dr. Berres, of Vienna, was the first, I believe, who published a process for etching Daguerreotype; his method was to cover the plates with a solution of gum-arabic, and then to immerse them in nitric acid of a certain strength. I have not seen any plates thus prepared, but the few experiments which I have made with nitric acid, have given

* From the Proceedings of the London Electrical Society, Part II, having been read before the Society on the 17th of August, 1841. Revised by the Author.

me a burred and imperfect outline; and I have experienced extreme difficulty of manipulation from the circumstance of the acid never attacking the plate uniformly and simultaneously. My object, however, in this communication, is not to find fault with a process which I have never perhaps fairly tried, or seen tried by experienced hands, and the inventor of which deserves the gratitude of all interested in physical science; but to make public another, which possesses the advantage of extreme simplicity, which any one, however unskilled in chemical manipulation, may practise with success, and which produces a perfect etching of the original image; so much so, that a plate thus etched can scarcely be distinguished from an actual Daguerreotype, preserving all the microscopic delicacy of the finest parts of the impression.

One sentence will convey the secret of this process; it is to make the Daguerreotype the *anode** of a voltaic combination, in a solution which will not of itself attack either silver or mercury, but of which, when electrolyzed, the anion will attack these metals unequally. This idea occurred to me soon after the publication of Daguerre's process; but, being then in the country, and unable to procure any plates, I allowed the matter to sleep; and other occupations prevented for some time any recurrence to it.

Admitting the usual explanation of the Daguerreotype, which supposes the light parts to be mercury, and the dark silver, the object was to procure a solution which would attack one of these, and leave the other untouched. If one could be found to attack the silver and not the mercury, so much the better; as this would give a positive engraving, or one with the lights and shadows, as in nature; while the converse would give a negative one. Unfortunately, silver and mercury are nearly allied in their electrical relations. I made several experiments with pure silver and mercury, used as the anode of a voltaic combination; but found, that any solution which would act on one, acted also on the other. All then that could be expected, was a difference of action. With the Daguerreotype plates I have used the following:—

Dilute sulphuric acid, dilute hydrochloric acid, solution of sulphate of copper, of potash, and of acetate of lead. The object of using acetate of lead, was the following:—With this solution, peroxide of lead is precipitated upon the anode; and, this substance being insoluble in nitric acid, it was hoped that the pure silver parts of the plate, being more closely invested with a stratum of peroxide than the mercurialized portions, these latter would, when immersed in this menstruum, be attacked, and thus furnish a negative etching. I was also not altogether without hopes of some curious effects, from the color of the thin films thus thrown down; here, however, I was disappointed: the colors succeeded each other much as in the steel plate used for the

* Strictly speaking this is a misapplication of Faraday's term: he applied it to the surface of the electrolyte; as, however, all continental and many English writers (among whom I may name Whewell) have applied it to the positive electrode, and as an expression is most needed for that, I have not hesitated so to apply it.

metallochrome, but with inferior lustre. On immersion in nitric acid of different degrees of dilution, the plates were unequally attacked, and the etching burred and imperfect. Of the other solutions, hydrochloric acid was, after many experiments, fixed on as decidedly the best: indeed, this I expected, from the strong affinity of chlorine for silver.

I will now describe the manipulation which has been employed by Mr. Gassiot and myself, in the laboratory of the London Institution, with very uniform success. A wooden frame is prepared, having two grooves at 0.2 of an inch distance, into which can be slid the plate to be etched, and a plate of platinum of the same size. To ensure a ready and equable evolution of hydrogen, this latter is platinized after Mr. Smee's method; for, if the hydrogen adhere to any part of the cathode, the opposite portions of the anode are proportionately less acted on. The back and edges of the Daguerreotype are varnished with a solution of shell-lac, which is scraped off one edge to admit of metallic connexion being established. The wooden frame with its two plates, is now fitted into a vessel of glass or porcelain, filled with a solution of two measures hydrochloric acid, and one distilled water (sp. gr. 1.1); and two stout platinum wires, proceeding from a single pair of the nitric acid battery, are made to touch the edges of the plates, while the assistant counts the time; this, as before stated, should not exceed thirty seconds. When the plate is removed from the acid, it should be well rinsed with distilled water; and will now (if the metal be homogeneous) present a beautiful sienna-colored drawing of the original design, produced by a film of oxychloride formed;—it is then placed in an open dish containing a very weak solution of ammonia, and the surface gently rubbed with very soft cotton, until all the deposit is dissolved; as soon as this is effected, it should be instantly removed, plunged into distilled water, and carefully dried. The process is now complete, and a perfect etching of the original design will be observed; this, when printed from, gives a positive picture, or one which has its lights and shadows as in nature; and which is, in this respect, more correct than the original Daguerreotype as the sides are not inverted; printing can therefore be directly read, and in portraits thus taken, the right and left sides of the face are in their proper position. There is, however, *ex necessitate rei*, this difficulty, with respect to prints from Daguerreotypes,—if the plates be etched to a depth sufficient to produce a very distinct impression, some of the finer lines of the original must inevitably run into each other, and thus the chief beauty of these exquisite images be destroyed. If, on the other hand, the process be only continued long enough to leave an exact etching of the original design, which can be done to the minutest perfection, the very cleaning of the plate by the printer destroys its beauty; and, the molecules of the printing ink being larger than the depth of the etchings, an imperfect impression is produced. For this reason it appeared to me, that at present, the most important part of this process is the means it offers of multiplying indefinitely Daguerreotypes, by means of the electrotype. An ordinary Daguerreotype, it is known, will, when electrotyped, leave a faint impression: but in so doing it

is entirely destroyed; and this impression cannot be perpetuated; but one thus etched at the voltaic anode, will admit of any number of copies being taken from it. To give an idea of the perfect accuracy of these, I may mention, that in one I have taken, on which is a sign-board measuring on the electrotype plate 0.1 by 0.06 of an inch, five lines of inscription can, with the microscope, be distinctly read. The great advantages of the voltaic over the chemical process of etching, appear to me to be the following:—

1st. By the former, an indefinite variety of menstrua may be used; thus, solutions of acids, alkalies, salts, more especially the haloid class, sulphurets, cyanurets, in fact, any element which may be evolved by electrolysis, may be made to act upon the plate.

2nd. The action is generalized; and local voltaic currents are avoided.

3rd. The time of operation can be accurately determined; and any required depth of etching produced.

4th. The process can be stopped at any period, and again renewed if desirable.

The time I have given is calculated for experiments made with one pair of the nitric acid battery; it is, however, by no means necessary that this be employed, as probably any other form of voltaic combination may be efficient. It would seem more advisable to employ a diaphragm battery, or one which produces a constant current, as otherwise the time cannot be accurately determined. It is very necessary that the silver of plates subjected to this process be homogeneous. Striæ, imperceptible in the original Daguerreotype, are instantly brought out by the action of the nascent anion; probably silver, formed by voltaic precipitation, would be found the most advantageous. I transmit with this paper some specimens of the prints of the etched plates, and of electrotypes taken from them; and in conclusion, would call attention to the remarkable instance which these offer, of the effects of the imponderable upon the ponderable: thus, instead of a plate being inscribed, as "drawn by Landseer, and engraved by Cousins," it would be "drawn by Light, and engraved by Electricity!"

I would suggest the employment of hyposulphite of soda instead of ammonia to remove the oxychloride. Philos. Mag., Jan. 1842.

London Institution, Saturday, Aug. 14, 1841.

The Artesian Well of Grenoble.

At Grenoble, in the vicinity of the French capital, it was considered advisable some years ago to endeavour to procure good water by means of an Artesian well. M. Mulot d'Epinay was the engineer to whom the task was entrusted. On the 31st of December, 1836, the bore had been carried, after immense labor, to the depth of 383 metres, (a metre is 3 feet and 2-10ths English.) The soil was a clay, very hard and compact. In the month of June, 1839, the bore had reached the depth of 466 metres, and the soil was still a bed of clay, though a variety of strata had been previous passed. M. Mulot kept

a regular journal of observations, relative to the soils and strata penetrated, and the temperature at different depths. This record will be valuable when published. At length, after a task of seven years one month and twenty-six days' duration, M. Mulot was rewarded by a degree of success proportioned to the time and trouble expended. Water was not only found, but found under such circumstances, and in such quantities, as will cause the well to be one of the most useful works as well as one of the greatest marvels of artistical ingenuity in France. The fluid burst out in a perfect torrent, rising to the surface of the bore to the amount of nearly three cubic metres in a minute, or 180 metres in an hour, and 4320 metres in the twenty-four hours. Such is the force with which it flows up the shaft, that it mounts more than thirty-two English feet above the surface of the ground. M. Hemery, director of roads and bridges, has calculated that the force of ascension of the water, at the bottom of the shaft, exceeds, by fifty times, the force with which water rises in a vacuated tube of thirty-three feet. The orifice of the well is fifty-five centimetres (about one foot eight inches) in diameter, and at the bottom it is eighteen centimetres in diameter. The shaft is in all 547 metres, (or 1630 French feet) in depth, and the sides are strongly plated with iron to a depth of 539 metres. The dome of the Invalids, which has an elevation of 300 feet above the ground, is thus only about a fifth of the perpendicular measurement of the Artesian well of Grenoble.

Three times, during the operations, did the shaft give way, but the indefatigable engineer was not daunted, and at last he has had his reward. The water, which the well pours forth incessantly, has converted one of the neighboring streets into a river, but the workmen are at present employed in forming a channel for its proper conveyance from the spot. As might be expected, the fluid was at first mixed with sand and earth, and continued to be so for some time. It is perfectly sweet, however, and had no odor of a disagreeable kind, or any other deteriorating qualities. It is of such a temperature, that there is an obvious smoke arising from it when it reaches the surface. This is a feature not likely to continue, and indeed easily removable before use. The whole cost of this great work of art to the city of Paris is said to have been 160,000 francs. The perseverance in this labour for such a period of deferred success, is to be ascribed to the confidence resulting from modern geological discoveries; and the value of these is most splendidly shown by the success attained. By an ingenious contrivance, M. Mulot has been able to raise large quantities of sand from the bottom of the well; thus clearing the water more rapidly, and also adding very considerably to its force and volume. This removal of the sand has been attended with curious consequences in more respects than one. After ceasing, in a great measure, to throw up sand, the well has begun to throw up shells and petrifactions of various kinds, the debris of a former world. The success of the operations of Grenoble has also induced engineers to make similar attempts in other quarters. One is begun on a large scale at Vienna.

Mining Jour.

Wear of Granite Pavement.

During seventeen months, the following was the relative wear of a pavement made of the granites named, laid down on the Commercial road in London:—Guernsey, 1.0; Herm (an island close to Guersey), 1.19; Budle (a Northumberland whinstone), 1.316; blue Peterhead, 2.08; Heyton, 2.338; red Aberdeen, 2.524; Dartmoor, 3.285; blue Aberdeen, 3.571. These differences are very considerable, and are, in a great measure, to be attributed to the mineralogical structure of the stone, granite being composed of at least three species, mica, feldspar, and quartz, of which the quartz is the hardest and the mica the softest. Permeability to wet is also a rapid cause of disintegration, especially in conjunction with frost. It is melancholy to see many of our public edifices rapidly hurrying to decay, from the bad quality of the stone employed in their erection. Great attention should be paid to the qualities of the stone, in selecting railway blocks; although the opinion of railroad engineers is now most inclined for timber bearings. Leaving out the question of first and last cost, longitudinal timbers with iron cross trees, decidedly make the most pleasant road; and the effect of this, not only on the passengers, but the engines and carriages will, in our opinion, put the ultimate cost on one side. We shall not easily forget the smoothness of the Great Western Railway, which was so evident as to admit of no doubt, although when we went on it, we were much prejudiced against it, from what we had heard; our prejudices were soon dispelled.—*Railroad Journal.*

Civ. Eng. & Arch. Jour. Nov. 1841.

Experiments on the Strength of Brick and Tile Arches. By Thomas Cubitt, Assoc. Inst. C. E.

In the course of his extensive building engagements, the author had occasion to construct some fire-proof floors; he therefore wished to ascertain how the greatest amount of strength could be attained, with a due regard to the space occupied, and the cost of the structure.

Two arches were built, each with a span of fifteen feet nine inches, and a rise of two feet.

The brick arch was two feet wide, and composed of half a brick in thickness, with cement.

The tile arch was two feet four inches wide, and built of four tiles, set in cement, forming a thickness of four and a quarter inches.

The spandrels of the arches were filled up level to the crown with rubble work and cement. A load of dry bricks was placed along the centre of both arches, and gradually increased at stated periods, from twelve cwt. three qrs. up to 160 cwt. at the end of seventy-five days, when the abutments of the brick arch gave way; and the tile arch broke down while loading.

Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Door Locks and Latches;* Enoch Robinson & William Hall, Boston, Massachusetts, March 3.

The latch bolt is connected with the fork, which is operated by the tumbler, or lever, on the spindle of the knobs, by a round shank surrounded by a helical spring—the fork being provided with a separate spring in the usual way. The spring on the shank of the latch should be of less strength than the one on the fork.

The object of this improvement is fully expressed in the following claim, viz: "We claim as our improvement arranging the latch bolt with an additional spring, which shall operate the same on closing the door to which the lock is applied, independently of the spring which acts on the knob, the whole being constructed substantially as herein set forth."

2. For an improvement in the machine for *Hulling Clover Seed;* William C. Grimes, York, Pennsylvania, March 3.

The patentee says,—"In the construction of machines for hulling clover seed, it has been a common practice to depend rather upon acute asperities to break the hull, than upon a more permanent principle, or structure, less affected by use; hence such machines have become speedily defective as they became worn; the seed passing through the machine in a current too thin, or diffuse, for the round teeth or asperities to act with sufficient force upon the light and scattered pods or hulls to break them."

"In my machine the hulling is effected while the chaff and seed (in a mass) is under a pressure produced by centrifugal force; thus the effective power of the machine is rapidly increased with its activity."

A runner is attached to the lower end of a vertical shaft, and is provided with teeth above and below, and on its outer periphery, which is rounded. The teeth on the upper surface extend much nearer to the shaft than on the under surface—the space between the inner ranges of teeth and the shaft being occupied by arms which admit of a current of air to pass upwards. The upper end of the shaft is provided with a fan consisting of arms or vanes—and the whole is surrounded by a case, that part which surrounds the fan, being provided with a valve or damper to regulate the current of air, and the part which surrounds the runner with teeth on the inside, to correspond with and pass between those on the runner.

The grain is fed in through a hopper, that opens into the case near the inner circle of teeth on the upper surface of the runner, and by the action of the centrifugal force it is forced outwards, towards, and around, the periphery, and then along the bottom towards the centre, where

it meets with a strong current of air, produced by the fan at the top, which carries up the chaff and permits the grain to fall down. The centrifugal force resists the escape of the grain at the bottom, but as the body of grain is greater at the top than at the bottom it is forced out.

Claim.—"What I claim as new, and as my invention, and desire to secure by letters patent, is the manner of hulling clover or other seed, under a pressure produced by centrifugal force, after the manner and upon the principle herein before set forth; that is to say, the seed in the hull is passed through a hulling chamber, in which it first diverges from, and then convey it towards, the centre; centrifugal force subjecting the seed and hull to a pressure, less or greater, according to the velocity of the wheel, spheroid or runner, as it passes over or around the bilge or periphery of the same."

Secondly.—"I claim the combination of the fan with the hulling wheel or ring, and operating after the manner, or upon the principle, above described."

Thirdly.—"I claim the mode of regulating or maintaining a nearly uniform current of air through the machine, by means of a valve or door, operating after the manner or upon the principle herein before set forth."

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3. For an improved mode of *Rendering Fabrics Water Proof;* George John Newberg, a citizen of the United States, residing in London, England, March 3; patent to run 14 years from the 12th of May, 1840, the date of the English Patent.

The patentee says—"My improvements in rendering silk, cotton, woollen, linen, and other fabrics water proof, consists in an improved mode, manner, or process, of rendering such fabrics water proof, and is effected by using drying oils and oil compositions, varnishes, or other suitable composition for this purpose, in such a way that one side of the fabric when finished presents an appearance unimpaired, or but little altered, by the process of water proofing, and therefore keeps its original appearance or nearly so, and this I effect by applying siccative, or drying, oils and compositions in such manner that when finished the appearance of one side only of the texture is altered, (that is to say,) the oil, or paint, or water proof composition, coats, or covers, the one side, while it does not cover or injure the appearance of the other side, or but little so.

"One method by which my improved mode, method, or process may be carried into effect is to use oil baths (about a quarter or half an inch deep will be found sufficient) of proper dimensions to allow the frame containing the strained silk, or fabric, to float thereon; the upper surface of the fabric being left exposed to the action of the atmosphere, or artificial heat. Another method, or modification of process, of carrying my improvements into effect is as follows, viz: by merely laying the saturated fabric on a slab, or slate, or stone, or metal, or other surface or material, non-absorbent to oils, or such mat-

ters, and this I consider a more simple and convenient method of effecting the objects of my improvements."

The method of producing damask patterns is thus stated—"Instead of having a plain table, or surface of slate, or of wood, placed in contact with that side of the fabric, part of which is only partially to be protected from the drying action of the air, or heat, I lay, or spread, the saturated silk, or fabric, upon a surface, or table, or block, which has a pattern formed upon it, such pattern being sufficiently countersunk, or raised, (say about one-eighth of an inch) after the manner of ordinary calico, or paper, stainer's pattern blocks. The raised parts of this pattern block, or table, being placed in close contact with one side of the saturated silk, or fabric, that is, the one intended to have the pattern formed upon it and the fabric stretched over it, the indented, or sunken parts, recesses, or interstices of the pattern not being filled with the composition, will allow the water proofing material to harden or become pellicled on both sides in some parts, while the raised parts will prevent such effect taking place."

"I claim, as new and useful, the improved mode, methods, or processes, or modifications above described, of applying substances to such saturated textures so as to prevent one surface thereof from drying, hardening, or forming a pellicle thereon, while the other is allowed so to do by the action of the atmosphere, or artificial heat, to which it is exposed, evaporating a portion of the aqueous or volatile parts of the oils, or compositions, and then afterwards clearing away the moist parts by the agency of spirits of turpentine, or other suitable liquids. And also, I claim the mode, manner, or process of producing damask patterns, or designs, on the surface of such fabrics, in the way or manner above stated."

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4. For a *Refrigerator;* Job S. Gold, city of Philadelphia, Pennsylvania, March 12.

This refrigerator consists of a square, or other formed, double box, with a space between the two, filled in with any bad conductor of heat. The inside is provided with shelves, open at the ends to allow of a free circulation of the air from one compartment to the other. At the top, or upper part, there is an apartment, or reservoir, for ice, and at the side there is another reservoir for ice water, the upper part thereof communicating with the bottom of the ice chamber, and the lower end being provided with a cock for drawing off the water.

The claim is, first, to the separate apartment for the ice at the top or in the upper part of the refrigerator, substantially as described. Second, to the combination of the ice water reservoir and the arrangement of the shelves with the apartment for ice as specified, for the purpose of producing the circulation of air to equalize the temperature, substantially as described. And third, to the ice water reservoir in combination with the apartment for ice, as described."

5. For improvements in the *Drill, or Seed Planter;* Moses and Samuel Pennock, East Marlborough, Chester county, Pennsylvania, March 12.

The claims, as well as the description, under this patent, refer throughout to the drawings, and could not be understood without them. This difficulty patentees might obviate by furnishing suitable cuts, when the whole specification might be published.

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6. For an improvement in the process, or processes, of *Manufacturing Starch;* Orlando Jones, Middlesex county, England, March 12; to run 14 years from April 30, 1840, the date of the English Patent.

The patentee says—"My invention relates to a mode of treating, or operating on, farinaceous matters to obtain starch and other products, and for manufacturing starch, by means of submitting such farinaceous matters to a caustic alkaline process, as hereafter more particularly explained. I would, however, observe that I have not yet found that my invention can be applied with advantage in the manufacture of starch from potatoes."

Claim.—"What I claim as my invention is, first, the mode of treating, or operating on, farinaceous matters to obtain starch and other products, especially flour, or powder, produced from rice, and in the manufacture of starch by submitting farinaceous matters to a process, or processes, of caustic alkaline treatment, as herein described. And secondly, I claim the mode of manufacturing starch from rice by the process, or processes, described."

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7. For improvements in *Circular Saws, and the mode of driving them;* David Philips, Georgetown, Mercer county, Pennsylvania, March 12.

The carriage which carries the log is moved by a horizontal screw, and is provided with two racks, the teeth of which take into two pinions on the shaft of the circular saw, so that the motion of the carriage which feeds the log up to the saw at the same time actuates the saw itself.

The other parts will be fully understood by reference to the claim, which is in the following words, viz:—"I do not claim as my invention the mere attachment of a series of plates for the purpose of making a circular saw, nor making the teeth separate from the plates, as these have been done before, but not, as I verily believe, in the manner specified by me, and therefore what I claim as my invention and desire to secure by letters patent is, the method of attaching the plates, or arms, to the main flanch by letting them into recesses, of the form above described, in the flanch, and having the second flanch, or plate, rivetted, or bolted, to the main flanch, embracing the plates, or arms; they, the plates or arms, being provided with long slots through which the rivets, or bolts, pass, and a key passing through the flanch and plate, and through a notch in the end of the arms, for the purpose of regulating the sweep of the teeth in their revolution as described.

I also claim the guide attached to each plate, or arm, in front of each tooth, for the purpose and in the manner described; also the method of fastening the teeth to the arms by means of the dovetailed wedge cap, as above described. And finally, I claim the method of giving motion to the saw, or saws, by means of the combination of the screws, the rack, or racks, attached to the carriage, and the pinion, or pinions, attached to the saw shaft, so that the motion of the carriage, received from the screw, shall give motion to the saw, or saws, as described."

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8. For an improvement in the *Ploughing and Planting Machine;* Justus Rider, Woodburn, Waconssin county, Illinois, March 12.

The reader is referred, for an explanation of this implement, to the claim, which is in the following words, viz:—"What I claim as my invention, and desire to secure by letters patent, is the combination of a cultivator, or of ploughs for the preparing of the soil, to receive the seed, consisting of an opening share with two coverers behind it, with a seed drill having an opener in front with two coverers behind, the seed being deposited at the back of the opener—the arrangement of the share constituting the cultivator preceding those of the seed drill, as set forth."

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9. For improvements in the *Horizontal Wind Mill;* John M. Van Osdel, Chicago, Illinois, March 12.

We are under the necessity, in this instance, of omitting the claims, as they refer throughout to the drawings, and could not be understood without them. The mill is horizontal, and as the sails are carried around they turn on their axes so as to present their surface to the wind in the best position to receive the action of the wind to impel the mill. The general position of all the sails can be shifted as the wind changes, whilst the mill is in motion.

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10. For improvements in the mode of *Constructing and Propelling Steam Vessels;* William W. Hunter and Benjamin Harris, Norfolk, Virginia, March 12—antidated November 2, 1840.

The patentees say—"The nature of our invention consists in providing the vessel with an arch deck, called a shield deck, faced with iron, which facing forms, with the direction of any missive discharged from cannon afloat, an angle over 130°, and will therefore glance, or throw, off said missive. Said shield deck, in combination with the parts of the vessel below it, gives (by its displacement of water) a buoyancy, by which said vessel will float, though the vulnerable parts of said vessel be pierced, or torn by shot, so as to admit all the water capable of entering. The steam engines, machinery, and water wheels, are placed below said shield deck, and every part of them below the water line, therefore out of the reach of shot, and the water wheels being, from their position, always submerged, are relieved from the effect of the sea."

The wheels work horizontally or inclined, in cases, or trunks, built

in the vessel and open at the side. The wheels consist of a drum, with the paddles attached permanently to the periphery thereof. A portion of each wheel projects out of the case, or trunk, beyond the side of the vessel, and the shaft passes through the casing, and the water is prevented from leaking into the vessel by means of a stuffing box.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the application of shield decks to vessels constructed of metal, or wood, whether propelled by steam power or any other, and also the application of submerged water wheels, on the plan described in the accompanying specification, whether placed horizontally, or obliquely, for the purpose of propelling vessels."

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11. For an improvement in the manner of *Manufacturing Butt Hinges, by casting them in combined metallic moulds;* Thomas Shepherd and Thomas Loring, district of Southwark, Philadelphia county, Pennsylvania, March 16.

The patentees say—"We construct our moulds of iron, placing one mould upon another, so as to form tiers, one above the other; and in each mould, at each pouring, we cast a half hinge, the moulds containing, in the first pouring, a pattern which occupies one half thereof, and which is so constructed that it can readily be removed, leaving the half hinge first cast in the mould; and we then, by a second pouring, cast the second half of the hinges. Instead of a joint pin we usually cast the knuckles of one half the hinge with conical depressions, or countersinks, which are to receive conical projections on the knuckles of the other half; but, if preferred, joint wires may be inserted in the ordinary way, the respective halves being cast without conical projections."

"What we claim, and desire to secure by letters patent, is the manner in which we have constructed and combined the respective parts of our combined metallic mould for casting butt hinges, as above set forth; that is to say, we claim the constructing of metallic moulds, so as to arrange them in tiers, one above the other, on each side of a metallic gate; and so as that the said mould shall contain, at the time of the first casting, the pattern in the form of a half hinge, divided so as to deliver readily from the cast half, as herein described. We also claim the manner of combining these moulds so as that the lower side of the pieces shall constitute the half mould for each hinge in the series; and likewise the so forming and arranging them as to render them capable of being reversed for the purpose of casting the second half of the hinge; the whole being formed, constructed and operating substantially as herein fully made known."

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12. For an improvement in *Clamps for Crimping Leather;* Josiah M. Read, Boston, Massachusetts, March 16.

This patent is for a mode of securing the leather to that kind of clamp in which the leather is drawn by a screw that passes through

the clamp and bears against the heel of the crimping board, or form. One of the jaws of the clamp has a stud, which passes through the upper jaw, and then by means of a wedge passing through a slot, or under a shoulder in the stud, the upper jaw is forced upon the under, and thus bites the ends, or corners, of the leather placed between them.

The claim is confined to this device for clamping the leather.

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13. For an improvement in the *Harvesting Machine;* Alfred Churchill, Geneva, Kane county, Illinois, March 16.

This machine is intended for thrashing all kinds of grain when standing in the field, without cutting the straw.

There are two chains, one on each side of the forward part of the machine, which chains pass over rollers, or pulleys, and to which four rods are attached at equal distances apart. Immediately back of these chains and rods is placed the thrashing cylinder and concave, which are of the usual construction; and between the chains and rods, and the thrasher, there is a cap, provided with hooks, which slides up and down. As the machine is pushed forward the rods on the chains catch the heads of grain and push them towards the thrasher, at the same time one of the rods on the chains catches the hooks on the cap, which is thus lifted up, the heads of grain are pushed under, the cap is then relieved, falls on to the grain, and holds it during the operation of thrashing.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described, of gathering and thrashing grain at the same time by means of the revolving rods, and oscillating or revolving cap, constituting the gatherer, in combination with the thrasher and concave, the whole being constructed and operating substantially in the manner set forth."

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14. For an improvement in *Gas Lamps;* Robert Cornelius, city of Philadelphia, Pennsylvania, March 18.

The patentee says that "the improvement consists in the manner of constructing the apparatus for conducting the gas from one of the burners of a hanging, or fixed, lamp, or of a girandole, by means of a descending tube, so as to cause it to issue from a burner at a convenient height for reading or for other purposes."

The end of the tube which is attached to the fixed burner fits into a cup of mercury attached to its base, for the purpose of preventing the gas from leaking out, and another burner is affixed to the lower end of this said tube at any desired height.

Claim.—"What I claim as constituting my improvement in the within described apparatus, is the manner in which I have formed the mercury cup within the body of a burner of brass, or of other metal, by lining the same with sheet iron, and having the jet affixed therein; and in combination therewith, the so constructing the upper end of the descending tube as to enable it to receive and contain the jet, and thus to obviate the necessity of its removal, when said de-

scending tube is to be used; the whole apparatus being constructed substantially in the manner set forth."

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15. For an improved *Machine for Boring the Conical Openings into the composition which constitutes the charge of War Rockets;* Alvin C. Goell, Washington, District of Columbia, March 18.

"It has been the practice heretofore," the patentee observes, "to bore the conical opening required in the composition of war rockets by means of a drill, or borer, running horizontally in a lathe, or other similar apparatus, a process by which the composition has not been freely delivered from the opening, and in the performance of which other difficulties have been encountered. In those cases, also, when it has been deemed necessary to remove the whole charge, the rockets have sometimes been put into water to dissolve out the composition, or it has been removed by other means which were inconvenient and wasteful."

The borer is attached to the upper end of a vertical shaft, to which part of the shaft there is attached a cup, or basin, to catch and retain the cuttings. The rocket is placed in a holder which slides up and down in the frame of the machine to present the rocket to the borer.

Claim.—"Having made known the manner in which I construct my machine for boring war rockets, and arrange and combine the respective parts thereof, I do declare that I do not claim to be the inventor of either of the parts thereof taken individually, nor do I claim the general arrangement of these parts, there having been machines made for other purposes bearing a considerable resemblance thereto; I therefore limit my claim to the particular manner in which I have adapted this instrument to the purpose of boring out war rockets and of collecting and preserving the composition with which the rocket was charged. That is to say, I claim the combining with the borer the cup, or basin, on the shaft, so as to bore out and collect the material from a rocket placed in a holder, or sliding frame, the whole being combined, connected, and operating as herein set forth."

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16. For improvements in the *Mortising Machine;* James King, Morristown, Morris county, New Jersey, March 18.

The shank of the chisel is cylindrical and fits into the end of a slide; and for the purpose of turning the face of the chisel in opposite directions, a pin, or handle, projects from the shank and plays in a notch cut out of the slide for that purpose. A helical spring is put on to the pin, or handle, which spring bears against its head and against the face of the slide, and consequently holds the chisel in its place whether turned with its face one way or the other.

The slide has rack teeth on it into which the teeth of two pinions work—there are rack teeth also on the inner face of the box in which the slide moves, into which one of these pinions gear; and on the shaft, or axle, of this pinion a handle is attached for the purpose of working the chisel; by this arrangement the chisel will be moved

double the distance, through which it would move if the pinion turned on its own axis. The other pinion above mentioned, has a spiral spring wound on its axis in the manner of a watch spring, which is coiled up by forcing down the spring, and which carries back the chisel when the handle is liberated.

Claim.—"What I claim, and desire to secure by letters patent, is the manner of applying and using the spiral spring on the handle for confining the handle in any desired position; and likewise the manner of applying a spiral spring for returning the slide and chisel, in combination with a mortising machine, such as is herein described, the whole operating substantially as set forth."

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17. For an improved apparatus for *Filing Saws;* Nelson J. Wemmer, Philadelphia, Pennsylvania, March 18.

A tube which receives the end of the saw file fits and turns in a block which is placed on, and secured to, a plate which is graduated with radial lines to indicate the inclination of the file. The graduated plate is placed on a table attached to the saw clamp.

The claim is to "the use of the block in combination with the tube passing through it, which tube receives the point of the file, as set forth. Also the combining with such a block, and its appurtenances, the graduated piece, in the manner and for the purpose set forth."

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18. For an improvement in the *Cross Cut Saw;* Henry Burger, Danville, Hendricks county, Indiana, March 18.

The saw is to be attached to, and strained in, a frame, or gate, and which is made to slide horizontally, by means of a crank and pitman, in the usual way. This horizontal frame is sustained upon a second frame which slides vertically, and is balanced by counter weights, suspended by cords passing over pulleys, which govern and regulate the feed.

Claim.—"All that I claim as my invention, and desire to secure by letters patent, is the vertical sliding frame, provided with cords, or ropes, and counter weights, in combination with the horizontal gate which slides in it, for the purpose and in the manner described."

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19. For an improvement in the *Lamp for Burning Camphine;* Michael B. Dyott, Philadelphia, Pennsylvania, March 18.

This patent is obtained for an improvement on, and has been added to, a patent granted on the 25th of August, 1840, and noticed in this Journal vol. ii, 3rd series, p. 263. By reference to the notice of the original patent the following claim will be fully understood, viz: "What I claim as constituting my invention is the constructing of the burner with its upper end closed, or forming a cap for the reception of the wick, without lateral openings, or joints, in the top, or cap, whilst it is at the same time capable of being removed or opened for inserting and adjusting the wick, the respective parts being formed as described."

20. For improvements in the *Machine for Making Pins;* John J. Howe, Derby, New Haven county, Connecticut, March 24.

The specification of this patent covers fifty-three folio pages, and is accompanied by numerous drawings, to which the claims refer throughout, and without which they could not be understood. A machine of this complex character does not admit of verbal description; we will merely observe that the wires are cut off, and received in carriers which are arranged radially around a wheel which successively carries them to cutters, revolving files, polishers, and other operating parts, until the pins are finished; the carriers receiving at each place the required rotary motion. The whole is arranged with much skill, and the manufacture is highly spoken of.

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21. For a *Square joint Dovetailing Machine;* William Perrin, Lowell, Massachusetts, March 24.

The nature of this "invention consists in arranging two circular cutters in such manner that they will cut the dovetails, and two other circular cutters to cut the pins to match, or fit, into the dovetails, and providing a carriage, with a slide and gauge to carry the boards to each pair of cutters."

"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the carriages one moving at right angles to the motion of the other, in combination with cutters arranged with their axles inclined, as described.

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22. For an improvement in the *Rotary Steam Engine;* Jesse Tuttle, Boston, Massachusetts, March 26.

In this engine, as in many of the old rotary engines, the chamber in which the piston works is formed by two plates, each having a semi-circular annular groove, which when put together form the chamber for the rotary piston to work in. The piston is attached to the outer edge of a plate which rotates on its axis between the two heads that form the piston chambers, commonly called the cylinder. On each side of this rotating plate is formed a cam groove, which receives a pin projecting from each side of a forked connecting rod, for the purpose of working the abutment valves. There are two of these abutment valves, placed on opposite sides of the piston chamber, with their forked connecting rods, the pins of which slide in slots made in the outer case of the engine. The steam chambers are situated on each side of the rotating plate, in which suitable appertures are made, as well as in the shaft, to conduct the steam from the side pipes to the piston. There is a sliding valve, with a handle, for changing the direction of the motion of the piston.

Claim.—"What I claim, and desire to have secured by letters patent, is the improvement of rotary engines by a combination not heretofore known; the said combination consists of the method of operating the abutment valves by means of the branched, or forked, connecting rods, having at each of their extremities a pin projecting at right angles

into the outer shell, or case, said pins working in a slot in the side of the case and operated upon by the cam upon the side of the rotating plate, as herein set forth. And the constructing of the steam chambers on each side of the rotating plate as described, connected with apertures in said rotating plate and shaft for conducting the steam to and from the piston, in combination with the side pipes and slide valves, the whole being combined, constructed and arranged as set forth."

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23. For an improvement in the mode of constructing *Fire Places and Chimney Stacks;* Henry R. Sawyer, city of New York, March 26.

The claim expresses the character of this improvement with much clearness, and we shall not, therefore, offer any further description of it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of constructing a foundation for chimneys in buildings where no chimney stack has been constructed below, by turning the arch of the hearth at its inner end, on an iron, or other metal, shoe, secured to trimmer pieces on either side, said shoe being supported on a column, or pier, which column, or pier, rests upon the sill, course, or wall, below, or foundation wall of the building, the whole being constructed and operating as described."

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24. For improvements in the machine for *Excavating Ditches;* George W. Cherry, Washington, District of Columbia, March 26.

The ditch is to be excavated by means of cutters attached to the extremities of arms projecting from an inclined shaft, the arms being kept at their proper relative distances by an inclined wheel attached to them. Some of the arms are hinged so that they may be raised up when the machine is to be removed from one place to another, and this is consequently effected without the necessity of lifting the whole wheel. There are cams on the side of the inclined wheel which, as the cutter wheel revolves, strike against a lever, to communicate motion, by means of falls and ratchets, to the wheels on which the machine rests, and which consequently move it forward as the ditch is excavated. At the forward part of the machine there is a grooved wheel which runs on a rail for the purpose of guiding it.

Claim.—"What I claim as my invention and improvement, and which I wish to secure by letters patent, is, first, the manner of moving the machine forward by means of the cams attached to the arms of the inclined wheel acting on the arm attached to the vibrating axle, and by the arms and palls communicating motion to the ratchet wheels, as described; but it will be remembered that I do not claim the method of giving a forward motion to the machine simply by means of the ratchet wheels and palls, except as above limited. Second, the connexion of two or more arms to the inclined axle by means of hinges, so as to raise them from the ditch, as specified. Third, the method of guiding the machine by means of the grooved guide wheel, in combination with the movable rail track, as described."

25. For an improvement in the *Life Boat;* Joseph Francis, city of New York, March 26.

The claim is in the following words, viz: "What I claim as my invention, and wish to have secured by letters patent, is the application of air, or gas, chambers, or other agent, as a buoyant power below the line of the keel of boats and vessels, and also in the run and entrance, or end of the boat, below the keel, called sheet cylinders, in combination with the improvement in the model, forming double bottom or low bilges on each side of the keel, which I claim also separately for all boats and vessels with or without buoyant power, as set forth."

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26. For improvements in the *Rotary Steam Engine;* J. Jamieson Cardes, a citizen of the United States and now residing at Newport, England, and Edward Locke, of Newport, Monmouth county, England, March 29, 1841—patent to run 14 years from the 8th of July, 1840, the date of the English Patent.

The reader is referred to the claim which is in the following words, viz: "We, the said J. Jamieson Cardes and Edward Locke, do hereby declare that the new invention, whereof the exclusive use to be granted to us by the said letters patent, consists in the rotary engine herein before described, the distinguishing character of which is that a revolving wheel is enclosed within an exhausted box, or case, and impelled and turned rapidly round by a continual current of steam entering with force and velocity into the exhausted space wherein the wheel is situated and impinging against suitable vanes, at the circumference of such wheel, in the direction of a tangent to that circumference. The said box being connected by an eduction pipe, with a condenser which is kept cool by means of cold water, so as to exhaust the steam from the box, at that part of the circumference of the said box where the steam ceases to act against the vanes; and that condenser having an air pump capable of continual action in order to keep up the exhaustion within the common condenser."

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27. For an improved apparatus for *Regulating the Pressure of Steam and other Fluids, confined in pipes and other receptacles;* Francis R. Torbet, Paterson, Passaic county, New Jersey, March 29.

In the constructing of this apparatus one end of a balance lever is connected, by a joint link, with a sliding valve, which governs the inlet of steam, or other fluid, and the other end of said balance is connected with a piston which works in a cylinder opening into the pipe, or other receptacle, into which the steam, or other fluid, has been admitted. A sliding counter weight is attached to one end of the balance lever so that by moving it farther from, or nearer to, the fulcrum, the pressure of the steam, or other fluid, will be regulated. It will be evident that if the pressure within the pipe be too great, the piston will

be forced up in its cylinder, which, by means of the connexion with the balance lever, will partially close the sliding valve, and vice versa.

Claim.—"I do not claim as my invention any parts of the machine as new in mechanics, nor as involving a new or peculiar motion, but I do claim as my invention, and not previously known or used, the general arrangement of the machine herein described and set forth for the purpose of regulating the pressure of steam and other fluids confined in pipes and other receptacles, by means of a piston, moved by the pressure of the fluid itself, and communicating its motion to a slide valve so as to reduce the aperture through which such fluid, but under greater pressure, is admitted."

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28. For an improvement in machinery for *Manufacturing Lead and other Pipes;* Benjamin and Henry B. Tatham, Philadelphia, Pennsylvania, assignees of John and Charles Hanson, of Huddersfield, York county, England, March 29, 1841. Patent to run 14 years from the 13th of August, 1837, the date of the English Patent.

This patent is granted for certain improvements in that kind of machines in which pipes are formed by forcing the metal through an annular opening by means of a piston; but heretofore this has been done whilst the lead was in a fluid state.

Claim.—"First—The manner of making pipes or tubes of lead or other suitable metals by pressing or driving with great force the metal, while warm, though not fluid, but in a set or solid state through the apertures, arms, or divisions, of the holder or bridge," (which supports the core) "and so causing the metal to reunite around the core under the pressure after passing the bridge."

"Second—The plan of feeding the cylinder through the aperture in the upper end, or side, of the cylinder opposite the dies, and closing the aperture by the entry of the piston, in combination with the reversed arrangement of the cylinder and piston as particularly set forth, for the advantage of discharging the pipes downwards, and for the other important facilities and purposes described. Third—The conical form of the chamber between the bridge and the dies, by which the metal is constricted in its passage under the pressure. Fourth—The combination of the guide piece with the long movable core attached to the piston, in the manner and for the purpose described. Fifth—The adaptation of the improved parts by which several lengths of pipe may be made at one and the same time and operation. Lastly—The mode of constructing the piston by which the packing is forced outwards against the inside of the cylinder by the pressure of the face or end of the piston against said packing as described."

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29. For an improvement in *Propelling Boats and other Vessels;* William W. Van Loan, Catskill, Greene county, New York, March 29.

The patentee says—"In my improved mode of construction and arrangement, I so place the paddle, or propelling wheels, as that their

axes shall form an acute angle with a vertical line, say of from fifteen to thirty degrees, more or less; and their planes, of course, form a like angle with the horizon." "What I claim, therefore, as constituting my improvement, and desire to secure by letters patent, is the placing of the said wheels in the position herein made known, so that they shall enter and leave the water in a direction similar to that of oars in the ordinary process of rowing, the whole operating substantially in the manner described."

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30. For an improvement in the construction of *Wheels for Propelling Boats,* steam ships, and water and wind mills; John Hobday and William J. Cooke, Portsmouth, Virginia, March 29.

In this operation the paddle boards are to pass through openings in the periphery of a hollow drum, and are jointed to a crank within it. The crank remains stationary, but the drum is made to revolve on its axis, and in consequence of this the paddles will be projected beyond the periphery of the drum during one part of their circuit, and will be drawn in during the remainder.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the introduction of a crank into a wheel, which, at the same time that it gives a new centre to the paddles, or arms, it enables them to protrude in time of action, and recede when not wanted for action, and at the same time makes the periphery of the wheel the forcing power on the arms, or paddles, and enables the constructer to make a wheel of the most powerful form."

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31. For an improvement in the machine for *Husking and Shelling Corn;* Samuel S. Allen, Miamisburg, Ohio, March 29. An improvement added to a patent granted on the 15th of January, 1840, and noticed in this Journal, vol. 1, 3rd series, page 199, to which the reader is referred.

Claim.—"What I claim as constituting my additional improvements in my machine for shelling corn, and which I desire to secure by letters patent, is the constructing my machine in such manner as that the convex posts of the frame are made to perform the office of the stationary pieces in the original machine; the movable staves, or curb pieces, being placed directly between the said posts, and these posts having the proper inclination for giving the proper form to the interior of the curb."

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32. For an improvement in the *Bee Hive;* William M. Hall, Wallingford, Connecticut, March 29. Improvement added to hive patent granted December 27, 1839, noticed in this Journal, vol. 1, 3rd series, page 107, to which the reader is referred for an explanation of the principle of the invention.

Claim.—"I do not claim as my invention the chamber with draw-

ers communicating with the hive below, nor sides adapted to cut off such communication, as they have been long known and used; but I do claim as my invention and new improvement, the direct communication between the drawers by means of corresponding orifices in each, as above specified, in combination with the right angled slides to close both orifices when a drawer is removed as above described."

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33. For an improvement in the *Counter Scales* for Druggists; Benjamin Morrison, Harrisburg, Pennsylvania, March 29.

This improvement is added to a patent granted February 16th, 1837, and noticed in this Journal, vol. xx, 2nd series, page 334, to which notice the reader is referred.

The improvement here patented constitues but a slight modification of the original scales as noticed above: and as the claims refer to the drawings, we shall omit them.

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34. For improvements in the machine for *Splitting Palm Leaf;* Carey McFarland, Barre, Worcester county, Massachusetts, March 31.

In this machine the palm leaf is split by means of grooved rollers and knives, and the waste and worthless pieces are separated from the good splints by means of two guides which carry them off. The good splints are discharged by the rollers into an inclined receiving board, and from thence into a sliding box which has a reciprocating motion that throws all the splints into a proper position for being made into bundles.

Claim.—"I do not claim as my invention the method above described of splitting palm leaf by means of the grooved rollers and knives, but what I do claim and desire to secure by letters patent is, the arrangement of the guides for separating the waste and worthless fragments of the leaf as described, and also the combination of the squaring box and receiving box for throwing all the pieces of palm leaf when split into proper position for bundling as described."

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35. For improvements in the machine for *Excavating Earth;* David C. Lockwood, New Windsor, Orange county, New York, March 31.

By means of a plough the earth to be excavated is thrown into partitions, made in an inclined wheel, and as the machine advances the earth is carried to the highest part of the inclined wheel and there discharged by lifting its inner edge which is attached to a lever. The machine runs on the lower edge of the inclined wheel, and on a small wheel, which runs within that portion of the rim of the inclined wheel which discharges the earth, so that a cart can run under this part of the inclined wheel to catch the earth discharged from it.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the within described mode of letting the dirt off from the wheel by lifting the stopboards which form the inner curb of the

hery—and also the described arrangement by which the supng wheel is brought within the inner edge of the upper part of eriphery of the inclined wheel, so as to allow a cart, &c., to re- the earth directly from the emptying stopboard."

Specifications of English Patents.

ification of a patent granted to Thomas Spencer, *of Liverpool, r an Improvement, or Improvements, in the Manufacture of cture and other Frames, and cornices; applicable also to other eful and decorative processes.* Enrolled September 8, 1841.

iese improvements consist of particular applications of the new important art to which Mr. Spencer originally gave birth, and are ied into ten heads.

ie first comprehends a method of manufacturing picture frames in er. For this purpose, a mould is made of the requisite pattern, which a series of reverse, or intaglio, moulds are cast, in the usual ner. The cast, if not a conductor of electricity, is made one, and er deposited upon it by the galvano-plastic process. When a ient thickness of copper is deposited, it is removed from the mould, its back filled up flush with solder, and a metal rebate placed d the inside, to receive the glass or picture. The frame is then for gilding.

condly, we have a similar method of producing moulds, by the no-plastic process, in which composition, or papier machée, ornas may be cast; such moulds being also applicable to glass, earthre, and china. An exact model of the ornament or other article produced, it is attached to a perfectly flat surface, and both beade conductors, copper is precipitated thereon by the galvanic ess. The copper mould thus obtained is tinned at the back, and up flush with metal, in order to give it the required strength.

iirdly, the patentee describes a mode of manufacturing obverse ds in copper for casting therefrom ornaments, &c., in iron. Any ed pattern is rendered a conductor of electricity, and coated with er by galvanism. In order to obtain a smooth surface at the back deposited copper, the cast on which the deposit is to be formed ced horizontally in the vessel containing the cupreous solution, its face downwards, and the copper surface which supplies the r is placed upon the bottom of the vessel. The mould thus ded may be used as an obverse mould for making patterns in sand on castings.

urthly, a mode of covering the surfaces of metallic picture or frames with gold; the same process being likewise applicable to surfaces, and to the rising or embossing of devices in gold or its s. For this purpose, a solution is prepared of pure gold, or of its s, in bromine or iodine, and to this mixture a few drops of sulc acid are added. The surface to be coated is cleaned in the

usual manner, and then immersed in the solution, being connected with the positive wire of a galvanic battery; a surface of gold to be eroded is connected with the negative wire, and the battery put in action, when a deposition of gold is effected of any desired thickness.

Fifthly, a mode of employing silver for covering surfaces. The solution is prepared as follows: silver is dissolved in bromine and alcohol, by means of galvanism, and this solution is allowed to precipitate a yellowish white powder; the liquid is then decanted, and the precipitate is boiled for ten minutes in thirty times its weight of a saturated solution of acetate of ammonia. Or a solution may be formed by dissolving an iodine of silver in prussiate of potassa, or any of the ammoniacal salts.

Sixthly, how metallic surfaces may be covered with platinum. For this purpose a quantity of platino-bichloride of ammonia is mixed with sixty times its weight of water, to which three parts of muriatic acid have previously been added; this mixture, after being boiled for about ten minutes, forms a solution, which is to be used in lieu of the usual solution of copper. Or bromine mixed with its bulk of alcohol is added to spongy platinum, and stirred or shaken till dissolved; this solution is then combined with half its bulk of dilute sulphuric acid, containing six times its weight of water, when it is ready for use.

If leaden surfaces are to be coated with platinum, they are cleaned by the usual method, and immersed for six hours in water containing half an ounce of either of the solutions of platinum to half a gallon of water; on its removal it will be found to have changed to a dark brown colour. If a more permanent coating be required, the lead is connected with a voltaic battery while in the solution, which should then be of double the strength. Lead so coated is applicable to surfaces used for the negative plates of galvanic batteries.

Seventhly, there is described a method of covering metallic surfaces with tin, applicable to the purposes mentioned under the fourth head. The metallic surface being thoroughly cleaned, is then placed with a surface of tin in a solution of acetate, or of muriate of ammonia, or sulphate of soda, and connected with a galvanic battery, by the action of which, tin is deposited of any thickness.

Eighthly, a mode of cleaning surfaces of iron, and then covering them with copper, by means of voltaic electricity. The iron to be cleaned is attached by a wire to the platinum end of a voltaic battery, consisting of three pairs of plates, each plate having the same quantity of surface as the iron to be operated upon; another surface of iron is attached to the zinc end of the battery, and the two surfaces immersed in a saturated solution of sulphate of soda. In a few minutes the surface will be ready to be deposited upon, when it is attached to the zinc end of a battery of three pairs of plates, and a piece of copper is connected with the platinum end of the battery; the copper and iron being immersed in a solution of copper, copper is deposited on the iron surface.

Ninthly, a method of producing enriched surfaces, applicable to picture frames, cornices, and other decorative purposes, by the use of embossed calico, paper, or other similar fabrics. The pattern being

embossed on the fabric by dies or rollers, is cut out and cemented on to the surfaces to be enriched, a coating of thick whiting being first applied to the hollow side to fill up the spaces, and give it the required strength.

Tenthly, a method of improving the texture of the composition used for casting ornaments for picture frames, cornices, and decorations, by adding to the materials usually employed for this purpose, caoutchouc dissolved in spirits of turpentine, asphalte, pyroligneous spirit, or spirit of tar, in the proportion of one pound of the caoutchouc to every six pounds of glue, used in making the composition.

The claim is, 1. To the application of voltaic electricity to the manufacture of picture and other frames.

2. To the application of voltaic electricity to the manufacture of moulds for the purposes mentioned.

3. To the application of voltaic electricity for the purpose of making patterns, or moulds, for iron founders, in copper.

4. To the use of bromine and iodine combined with gold, in conjunction with voltaic electricity, for the purposes before mentioned.

5. To the use of bromine and iodine combined with silver, in conjunction with voltaic electricity, and applicable to the surfaces mentioned under the fourth head.

6. To the use of the solution of platinum, in conjunction with voltaic electricity.

7. To the use of bromine combined with platinum, and in conjunction with voltaic electricity.

8. To the covering of lead with platinum, and applying it for the first time to the use above mentioned.

9. To the covering of the surfaces mentioned under the fourth head with tin, by the particular methods described.

10. To the method of cleaning iron surfaces, and the regulation of the quantity and intensity of electric force necessary to render iron fit to be deposited on, for the first time pointed out.

11. To the method of producing embossed or enriched surfaces on picture and other frames, and cornices, being also applicable to other interior decorations.

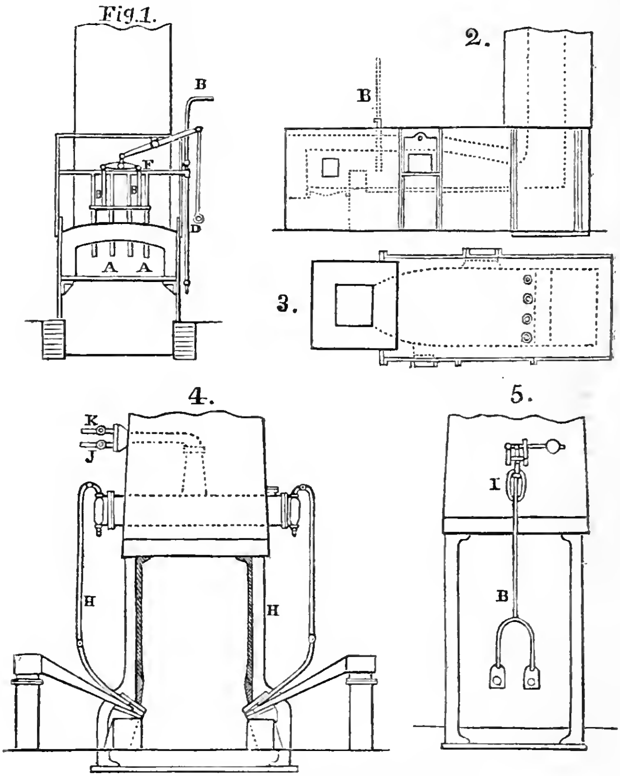
12. To the application of caoutchouc for the purposes before mentioned.

Mech. Mag., Oct., 1841.

Specification of a patent granted to Josiah John Guest, *of the Dowlais Iron Works, Glamorgan, and* Thomas Evans, *of the same place, for certain improvements in the Manufacture of Iron and other metals.*

The nature of this invention consists in forcing damp steam into the melted mass of metal, whatever it may be, contained in the melting furnace used for melting the said metal in, and particularly into the melted iron in refining and puddling furnaces, as also in a certain paste made with the said steam and melted cinders, and applied as hereinafter explained; and the following is a description of the man-

ner in which the said invention is to be performed, with reference to iron, reference being had to the drawings, and to the figures and letters marked thereon:—



Description of the Drawings.

Fig. 1 represents the front elevation of a puddling furnace. A jet, or jets, of steam is, or are, introduced into this furnace, in contact with the melted iron, while in a state of what is usually called fermentation; the steam is conducted through the roof of the furnace, as here shown, through wrought iron telescope tubes, sliding one over the other, by means of which tubes we are enabled to convey the steam very near to the surface of the fluid iron to be acted upon; the success of the operation depends much on bringing the steam in close contact with the melted iron; therefore, any other plan of introducing the steam close to the iron may be found to answer the same purpose—the steam that we have used for our experiments has been supplied from the ordinary engine boiler; but, as shown in the case of the refinery furnace, fig. 4, we purpose generating the steam in the chimney of the furnace; the pressure we have used in the puddling furnace has been about fifteen pounds to the inch, through four pipes, A, A,

three-quarters of an inch in diameter, which answers very well during this process, in order to keep the sides, bridge, and bottom of the furnaces from burning. We introduce a quantity of steam upon the fluid cinders as soon as the heat is drawn until the cinders become of the consistency of paste; we then, with a rabble or rake, rake as much of that paste, and place it against the back, sides, and bridge of the furnace, as may be required, to fill any cavity that may have been burned during the previous heat of iron; the use of cinders in a state of paste for repairing the bottom and sides of the furnace keeps the iron quite clean and free from dirt, which is always found from the use of clay and limestone, as at present used. The tubes, A, A, which pass through the roof of the furnace, slide over the tubes B, B, forming thus telescope tubes, and they are raised or lowered according to the quantity of fluid metal in the furnace, by means of the lever, C, and handle, D, by which it is worked; the dotted line shows the height of the fluid metal. E is the steam pipe; F the connecting pipe, for communicating alike to all the four telescope tubes; and G is a condensed water pipe.

Fig. 2 is a side elevation.

Fig. 3 a plan of the puddling furnace.

And now, as to the refinery furnace; we introduce a jet, or jets, of damp steam, after the pig iron is melted, through the same aperture as the blast; the quantity and temperature of the steam must depend upon the quality of the pigs to be acted upon; we use four pipes of half an inch in diameter, with a pressure of twenty pounds to the inch, and find it answers our purpose; the steam is by us generated in the chimney of the refinery furnace, but it may be conveyed from the engine boilers.

Fig. 4 represents a side elevation of our steam apparatus, shown in two of the four tuyeres or apertures of a refinery furnace.

Fig. 5 is another view of it. In fig. 4, H H, are two of the steam pipes, the steam being generated in the tube, or cylinder, I, in the flue or chimney, which cylinder, I, is filled with water—J being a water feed pipe, and K a pipe on which to place a safety valve.

Now, whereas we propose to apply steam in a similar way in the melting of alloys of copper and iron, and of tin and iron, which alloys can be made in refinery and puddling furnaces by it; but in particular we apply our said invention to the manufacture of iron, whereby we obtain a better material with greater economy. And we claim as our invention the use, or application, of steam forced upon, or into, or in contact with, the melted iron, in refinery or puddling furnaces for the manufacturing of the same. And also the similar use of steam in the process of melting or manufacturing alloys of copper and iron, and of tin and iron, in such furnaces; and also the application of steam to fluid cinders, as hereinbefore described, to produce the paste aforesaid, and the use or application of the said paste, as aforesaid.—*Repertory of Patent Inventions.* Mining Jour., Nov. 1841.

Specification of a patent granted to WILLIAM JEFFERIES, *of Holme street, Mile end, for improvements in obtaining Copper, Spelter, and other metals, from ores.*

This invention relates, first, to a mode of obtaining copper from copper ore; and, secondly, to a method of obtaining zinc from zinc ores.

The patentee says, his improvements are confined to the smelting process, and prefers the ores to be in a raw state, instead of calcining or roasting previous to smelting; the ores may, however, be roasted or calcined previous to smelting. If this invention is to be applied to a smelting furnace, worked according to the old plan, the furnace is charged with raw or calcined ore; and when it has been well skimmed, a quantity of carbon or alkali, ground to a fine powder, is stirred into the melted mass, friable, in which state it is pushed forward to the bridge, and the heat continued until the mass is well melted; the furnace is then tapped, and the metal run off into water, leaving the slag in the furnace; then charge the furnace again, and treat the charge with carbon or alkali, as above described. It is not necessary, however, to tap or draw off the metal after each charge, as two or three charges may be added, and treated with alkali or carbon, previous to tapping. The carbon preferred by the patentee is anthracite coal or charcoal, and when alkali is used, he prefers common soda, but does not confine himself to it alone. The metal obtained by this process must subsequently be treated in the same manner as metal obtained in the ordinary way; and, as this after process is well known, it will not be necessary to give any further description.

Fig. 1.

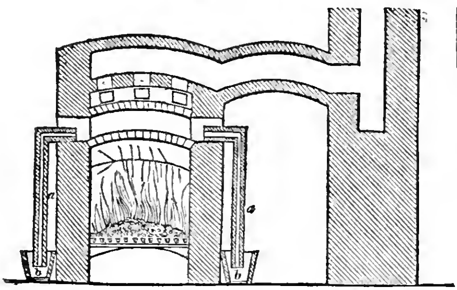


Fig. 2.

The second part of the invention relates to a method of smelting fine ores, and consists in carrying on the smelting process in large ovens, heated externally, by which means a large quantity of ore may be operated upon at once, at a very reduced cost, and zinc produced of most excellent quality. The description of oven and furnace employed by the patentee, is shown at fig. 1, which represents a transverse section of an apparatus, suitable for treating three or four tons of ore at the same time, instead of having a number of small vessels or retorts in a furnace. From the upper as well as the lower parts of

such oven, several small pipes, *a a*, descend into vessels, *b b*, containing water; and, as distillation proceeds, the metallic zinc will (as it becomes evaporated) pass down the pipes, *a a*, and be cooled. In constructing an oven for this purpose, the bottom and roof should be as thin as possible, so as to allow the heat to pass freely through the fire-brick, and at the same time the bottom must be strong enough to support the charge of ore. The fire-bricks, of which the oven is composed, are therefore of a peculiar form, as shown at fig. 2; and, by this means, the bottom of the oven may be made of three inch bricks, and the arch, or top, of two inch bricks.

In working, according to the improved mode, we will suppose that the oven has been at work, and is ready for a new charge; the ore is taken and mixed with about five per cent. of small bituminous coal; the oven is then charged as full as possible, and the mouth closed and luted with fire-clay; continue the fire, and distillation will proceed, as when small vessels or retorts are used, the metal passing down the pipes into the receivers as it is distilled. As there are several pipes to conduct off the distilled metal, care should be taken that none of these pipes are left open to admit atmospheric air. When the charge is worked off, the oven is opened, and the refuse or slag drawn out, and a fresh charge immediately supplied.

In conclusion, the patentee says, that although he has been particular in describing the exact means he pursues, yet he does not mean to confine himself thereto, so long as the general character of the different parts of the invention are retained. And he claims, as the first part of the invention, "the mode of smelting copper ores, by treating the melted metal with carbon or alkali, as above described; and, secondly, the mode of obtaining zinc from ores, by means of ovens, as above described."

Ibid.

Specification of a Patent granted to Hugh Lee Pattinson, *of Durham, for improvements in the Manufacture of White Lead.* Enrolled September 10th, 1840.

This invention consists in the application of carbonate of lime to certain salts of lead, so as to produce a decomposition of the said salts of lead, and a reciprocal exchange of acids and bases between the carbonate of lime and the salt of lead employed. By this chemical re-action, carbonate of lead, or white lead, and a solution of lime, are obtained;—the composition of the latter depends upon the particular salt of lead made use of in the process.

The salts of lead employed, are the chloride and the nitrate; and in order to make the invention more perfectly understood, the patentee has detailed the chemical phenomena which take place when carbonate of lime and chloride of lead re-act upon each other; but, as our space is rather limited, we must pass on to a description of the practical means required to manufacture white lead, according to the improved process.

The patentee uses a mill of the following construction, to triturate

the materials of which the white lead is composed. It consists of a strong wooden tub, secured with iron hoops, the bottom of which is formed of blocks of hard stone, firmly cemented together, so as to present a level surface. Other larger blocks, of the same kind of stone, are carried round upon this bed, by machinery, so that any hard and brittle substances, when placed in the tub with water, are continually rubbed under it, until reduced to the finest powder.

This description of mill is employed, because it continually mixes, and rubs together, the materials submitted to its action. Care should be taken that no iron, employed in the construction of the mill, may be so situated as to be liable to act upon the bodies to be ground; and where metallic fastenings are required, copper may be used. Into a mill of this kind, twelve feet in diameter, and three feet deep, put twenty-one hundred weight of chloride of lead, and seven and a half hundred weight of carbonate of lime, in the form of the best washed chalk or whiting; then partly fill the tub with water, and put the mill in motion. After the materials have been ground from four to six hours, cease grinding, and add more water, until the tub is nearly full; then suffer the whole to stand till the next morning, when a white mass, consisting of carbonate of lead, mixed with undecomposed carbonate of lime and chloride of lead, will be found at the bottom of the tub, and above this, a clear liquor, which is a strong solution of chloride of calcium, nearly free from lead. This solution must be drawn off, by means of a syphon or plug, and as much fresh water added as the tub will conveniently hold; then the grinding is renewed for a few hours; and when stopped, the materials are allowed to settle as before, and the solution again drawn off, and fresh water added, the grinding being continued again for a few more hours. The process is continued, day after day, in this manner, the supernatant liquor becoming every day a weaker solution of calcium, nearly free from lead, until at the end of seven or fourteen days it is nearly tasteless, when the decomposition is considered to be complete, and the white mass, at the bottom of the tub, will have become very nearly a pure carbonate of lead; in which state it is removed from the tub, and dried and prepared for the market in the usual manner.

When the patentee uses water, impregnated with carbonic acid gas, instead of grinding the materials together, as above described, he employs the following apparatus:—

A barrel, made of lead, wood, or copper, strongly hooped with iron, and of any convenient size, is mounted on gudgeons; to one of which, a fast and a loose pulley are connected, and rotary motion is communicated thereto from machinery, by means of a band. The other gudgeon is made hollow, and communicates with the interior of the barrel; it is also furnished with a stop-cock, and, by means of a screw-joint, may be connected to a force-pump, for the purpose of forcing carbonic acid gas into the barrel.

One hundred and forty pounds of chloride of lead, and fifty pounds of carbonate of lime, are introduced into the barrel, through an aperture made in the end thereof; then the barrel is nearly filled with pure water, and the aperture is closed by means of a screw-plate and

leather washer. Carbonic acid gas is then forced into the barrel, by means of the force-pump, until the water is saturated under a pressure of four or five atmospheres; after which, the barrel is made to revolve at the rate of twenty revolutions per minute, and the substances within immediately begin to act upon each other; the carbonic acid solution dissolving the carbonate of lime, and presenting it to the chloride of lead in a better form for decomposition than when solid, or nearly so. This operation is carried on for three or four days; at the expiration of which, the action has advanced so far, that very little chloride of lead, or carbonate of lime remains, and the liquid is a strong solution of chloride of calcium, which, when the insoluble mass is settled, may be removed from the barrel in any convenient manner, and a further quantity of water, impregnated with carbonic acid, must be added, and the barrel set in motion for a day or two longer, until the decomposition is perfected.

When nitrate of lead is used the same process is adopted with the chloride, except that the exact chemical equivalent of the two substances is employed. In the grinding tub, twenty-four hundred weight and nine-tenths of nitrate of lead, and seven and a half hundred weight of carbonate of lime, are ground together; and in the barrel, one hundred and sixty-six pounds of nitrate of lead, and fifty pounds of carbonate of lime are introduced. In both cases, the two substances are allowed to re-act upon each other, until the decomposition is complete; after which the carbonate of lead is removed, and prepared for sale. Lond. Jour. Arts & Sci.

Specification of a patent granted to John Henry Le Keux, *of Pentonville, for an Improvement in Line Engraving, and in producing impressions therefrom.*

This improvement consists in engraving a subject on two plates, one portion of the subject on one plate, and the remainder on the other, so that when printed, the combination of the two impressions shall produce the effect required.

Two plates being prepared for engraving, on one of them is put a tracing of any given subject. The outline and dark shadows are then etched on this plate, and finished by the usual process of line engraving; this plate is called the subject plate.

A tracing, or transfer, from the above is then placed on the other plate, and a tint of lines is ruled all over the subject; the lights are then stopped out, and the under tints, or shadows, are produced by biting in; thus forming what is called the ground plate. The plates being marked with register lines are printed, one upon the impression of the other, so as to produce the effect sought.

The claim is to the ruling of a tint of lines, and then producing the required under tints, lights, or deep shadows, on a separate plate from that on which the general subject is engraved, and then taking impressions from the two plates so engraved in the manner described (both being engraved in the style called line engraving,) whereby an entirely novel effect is produced, with a considerable saving of labour.

Mech. Mag. Sept., 1841.

Specification of a patent granted to RICHARD LAWRENCE STURTEVANT, *of Bethnal Green, for Improvements in the Manufacture of Soap.* Enrolled September 8, 1841.

These improvements consist in manufacturing hard soap at one operation in the ordinary boilers, without separation of lees, or precipitation of niger, which is effected by using some, or all, of the following ingredients, viz., cocoa-nut oil, palm oil, tallow oil, and potash lees. Also the muriates of soda and potash.

The specific gravity of the lees is measured by Beaumé's hydrometer, at a temperature of 62° Fahr.

The following is the mode of making white soap: 2,072 lbs. of cocoa-nut oil, (in its raw state, or deprived of its rancidity in the manner hereafter noticed;) 168 lbs of olive oil, sweet oil, or tallow; 375 gals. of soda lees at 24°, and 60 gals. of potash lees at 20°, are boiled together in the following order:—The cocoa-nut, and other, oil, or tallow, are first put into the copper, which may be heated by fire or steam; 10 gals. of the soda lees are then added, and the mixture allowed to boil; the remainder of the soda lees is added from time to time in similar quantities, the mixture being kept boiling. In about ten minutes after the whole of the soda lees have been put into the copper, about 84 lbs. of muriate of soda, or potash, are slowly sprinkled over its surface, and the mixture boiled for half an hour, when the fire or steam is withdrawn, and the soap is finished, and is to be cleansed or framed, when cool, in the usual way.

A hard soap for fulling, and such like purposes, is composed of the following ingredients, viz., 1,792 lbs. of cocoa-nut oil; 336 lbs. of tallow; 224 lbs. olive oil; 112 lbs. of rape oil, or of colourless palm oil; 400 gals. of soda lees at 25°, and 80 gals. of potash lees at 20°.

All these ingredients being put into the copper, the heat is applied, and the operation conducted as above, except that the muriates of soda or potash are not used, but as soon as the soap is made, 2,240 lbs. of grained, or curd soap, made upon the old plan, is added, and the mixture boiled until the two soaps are thoroughly incorporated.

To remove the rancidity of cocoa-nut oil, 10 cwt. of it is boiled in a wooden vessel by steam, with three pounds of sulphuric acid, or six pounds of muriatic acid. Or the oil is boiled alone for a sufficient length of time in an iron pan, by means of a dry heat.

The claim is, 1. To the making of hard soap, at a single operation, without separation or removal of lees, or precipitation of niger.

2. To the use of cocoa-nut oil, in conjunction with other materials, in the manner, and for the purpose, described.

To the mode of depriving cocoa-nut oil of its rancid and unpleasant odour by the processes described.

4. To the use of potash lees for the purpose of improving the quality and appearance, and giving a greater tenacity to soap.

5. To the use of muriate of soda, and muriate of potash, for the purpose of giving greater tenacity and hardness to soap.

6. To the ascertainment with greater falicity and accuracy of the

quantities and proportions of alkaline lees requisite to be used with the other ingredients in the manufacture of soap.

7. To the mode of making a fulling soap, or soap for manufacturing purposes, in the manner described.

Ibid.

Specification of a patent granted to Joseph Maudsley, *of Lambeth, for an Improvement in the Arrangement and Combination of certain parts of Steam Engines, to be used for Steam Navigation.* Enrolled September 16, 1841.

This improvement consists of an arrangement of marine steam engines. The steam cylinder has a small open topped cylinder placed concentrically within it; the piston is a broad rim, or annulus, which fits the space between the interior of the large, and exterior of the small cylinder. The piston is jointed to the lower end of the connecting rod in the following manner; two vertical piston rods rise from opposite sides of the piston, and passing up through stuffing boxes in the cover, are united to a T-shaped cross-head; the upright stems of this cross-head descend into the small cylinder, and the lower ends are attached to a guide block, to which the connecting rod is also attached by a joint pin; which pin, according to the length of the upright stems of the cross-head, may be placed either above or below the piston, or level with it. The cross-head is composed of two parallel plates, united at the extremities of the horizontal arms, a sufficient opening being left between them for the working of the connecting rod.

The claim is to the improvement in the arrangement and combination of the different parts of steam engines to be used for steam navigation. The distinguishing character of that improvement being, that the connecting rod, with its appurtenances, is situated, and works, within a small open topped cylinder, which is fixed in the central part of the steam cylinder, and within the central part of the annular piston.

Ibid.

Specification of a patent granted to John Deane, *of Dover, for Improvements in Preparing Skins, and other animal substances, for obtaining gelatine, size, and glue, and in preparing skins for tanning.* Enrolled August 23, 1841.

The hair is first removed from the skins, by placing them in a solution of lime, potass, or soda, in the proportion of from 8 to 26 lbs. of lime, and from 4 to 16 lbs. of potass or soda to every fifty gallons of water. The skins are then placed in a revolving cylinder formed of bars of wood or metal, or a perforated surface of wood may be used, and the cylinder being placed in a trough filled with any of the before mentioned solutions is caused to revolve until the action of the lime, &c., aided by friction, has removed all the hair. The skins are then taken out of the cylinder, fleshed or shaved, and washed until thoroughly cleansed. They are then steeped in a large vat of water,

until a slight putrescence is apparent, when they are removed to suitable vessels, and covered with water, into which is poured from 6 to 28 or 30 lbs. of hydrochloric acid from each cwt. of animal substance. The vessel is then covered over, and the skins left to the action of the acidulated water from eight to twenty-four hours, or until the skins assume a white semi-transparent appearance, when they are taken out and thoroughly washed in cold water, and afterwards deposited for two or three days in a tank, through which a current of fresh water flows continually. Instead of the hydrochloric acid in solution, the skins may be treated with hydrochloric acid gas. Hides, &c., are subjected to the above processes, and then tanned in the ordinary way.

The claim is to the use of a rotating, perforated, or other, cylinder, for the purpose of unhairing the skins, hides, or pieces, to be used in the manufacture of gelatine, size, or glue; when used in combination with a solution of lime, potass, or soda, or combined portions of either. Also, the application of hydrochloric acid, or hydrochloric acid gas, or either of them diffused in water, in whatever manner they may be employed; when applied to hides, skins, or other animal substances, for the purpose of preparing them for the manufacture of gelatine, size, or glue. Also the sole application of the above mentioned acid and acid gas to hides and skins, for the purpose of preparing them for being tanned.

Ibid.

METEOROLOGICAL OBSERVATIONS FOR MARCH, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	40°	58°	30.00	30.00	SE. SW.	Moderate		Cloudy.	Flying clouds.
	2	38	59	29.70	29.50	SE. SW.	do	.08	Drizzle.	Drizzle.
☽	3	50	71	29.73	29.73	W.	do		Clear.	Clear.
	4	54	63	29.73	29.70	SW NW.	do	.15	Par. Cloudy.	Thunder shower.
	5	59	66	29.55	29.70	W.	Brisk		Clear.	Flying clouds.
	6	43	46	30 00	30.00	E.	Moderate		Cloudy.	Cloudy.
	7	42	42	29.86	29.86	W. NW.	do	.31	Cloudy.	Rain.
	8	31	44	30.26	30.30	SW.	do		Clear.	Clear.
	9	40	41	30.10	29.84	SW.	do	.24	Cloudy.	Rain.
	10	57	67	29.84	29.84	SW.	do	.12	Cloudy.	Cloudy, rain.
	11	41	52	29.60	29.60	NE. NW.	do		Cloudy.	Partially cloudy.
⊗	12	23	32	30.25	30.36	NW.	do	.02	Clear.	Clear, snow in night
	13	32	45	30.16	30.10	SE. W.	do		Cloudy.	Cloudy.
	14	36	49	30.10	30.10	W. SE.	do		Cloudy.	Cloudy.
	15	34	49	30.06	30.06	W.	do	.08	Clear.	Cl'dy, thunder sh'r.
	16	32	50	30.25	30.25	SW.	do		Clear.	Partially cloudy.
	17	40	60	29.95	29.84	SW.	do		Cloudy.	Cloudy.
	18	44	62	30.00	30.10	NW.	do	.37	Clear.	Lightly cl'dy, th.sh'r
☾	19	40	66	30.00	29.90	SE. W.	do		Par. Cloudy.	Hazy.
	20	55	67	29.90	29.85	SW.	do	.14	Cloudy.	Lightly cl'dy, th.sh'r
	21	38	37	30.00	30.05	NE.	do		Par. cloudy.	Cloudy.
	22	34	39	29.85	29.85	NE.	do		Rain.	Cloudy.
	23	33	44	30.10	30 13	E.	do		Cloudy.	Cloudy.
	24	35	45	30.16	30.16	SE.	do		Cloudy.	Cloudy.
	25	40	42	29.80	29.70	E.	do	.55	Rain.	Cloudy.
☉	26	40	47	29.70	29.80	W.	Brisk.		Cloudy.	Flying Clouds.
	27	33	58	30.10	30.04	W.	do		Clear.	Clear.
	28	41	48	29.85	29.95	NW.	Blust'ring		Clear.	Flying clouds.
	29	31	52	30.24	30.24	W.	Moderate		Clear.	Clear.
	30	42	68	29.60	29.60	SW.	do		Par. cloudy.	Cloudy.
	31	45	50	29.90	29.90	NW.	Brisk.		Clear.	Flying clouds.
		40.13	52.23	29.93	29.94			1.96		

Thermometer.		Barometer.	
Maximum 71.00 on 3rd. Minimum 23.00 on 12th.	Mean, 46.18.	Max. 30.36 on 12th. Min. 29.50 on 2nd.	Mean 29.935.

Co…	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1														
2	5⅓	1	4	⅓	6⅓	1⅓	.	9⅓	....	.	.....	....	..	1750
3														
4	7⅔	1⅓	2⅔	1⅓	12⅓	⅓	.	⅔	....	.	.....	....	..	1613
5 I														
6 I														
7 I														
8 V														
9 S														
10 I	2⅓	.	7⅔	.	11⅓	⅔	.	.	....	.	.....	....	..	1624
11 S														
12 E	1	⅓	4⅓	1⅔	3⅓	.	10	5⅔	....	.	.....	....	..	1628
13 C														
14 D														
15 L		.	.	.	.	.	.	.	....	.	.....	57.72	17	1610
16 Y	4⅓	1⅔	2⅓	2⅔	3⅔	2⅔	.	⅔	42.39	1	.....	50.39	1	1643
17 L														
18 D														
19 N	1⅔	.	6⅔	.	11	.	.	⅓	....	.	.....	....	..	1602
20 C	1⅔	.	4⅔	.	4⅓	.	5⅔	.	....	.	.....	53.23	1	1612
21 B														
22 T														
23 Ly														
24 U														
25 M														
26 Ju														
27 Pe	1⅓	.	1⅔	.	5⅓	.	14⅓	5	....	.	.....	....	..	1609
28 Cu														
29 Ad	2	.	7⅔	⅔	7⅓	1	6⅓	.	....	.	.....	....	..	1618
30 Fr	8⅔	1⅓	2⅓	1⅓	8⅓	1	.	.	42.12	.	.....	48.21	..	1654
31 Hu														
32 Ce	.	.	20	.	.	.	.	⅓	....	.	.....	....	..	1629
33 Pot	3⅓	⅓	3	.	4⅓	.	.	9⅓	....	.	.....	....	..	1611
34 M'l														
35 Cle														
36 Ca														
37 Be	2⅔	.	8	.	8⅔	.	.	4⅔	....	.	.....	....	..	1614
38 Son	7⅓	⅓	1⅓	8⅓	7⅓	.	.	⅔	....	.	.. .	....	..	1616
39 Ind	2⅔	.	3	1⅓	1	.	8⅔	9⅔	....	.	.....	48.24	10	1621
40 Jeff														
41 Wa	.	.	.	.	.	.	.	.	....	.	.....	....	..	1626
42 Ven														
43 Arm	3⅓	.	.	.	22⅔	.	.	⅔	....	.	.....	....	..	1737
44 We														
45 Fay														
46 Gree														
47 Was														
48 Alle														
49 Beav	1⅓	.	⅔	.	8⅔	1	9⅔	3⅔	....	.	.....	....	..	1615
50 Butl														
51 Merc	6⅓	.	13⅓	.	1⅔	.	.	.	....	.	.....	....	..	1622
52 Craw														
53 Erie,	1⅓	.	⅔	.	1⅔	.	12⅓	⅔	....	.	.....	....	..	1617

METEOROLOGICAL REPORT FOR THE STATE OF PENNSYLVANIA, Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for OCTOBER, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1 Philadelphia,	Philadelphia,	E. W. Hamilton,	45.29	58.73	49.80	72.00	29.00	51.27	7⅓	26.00	39.33	4
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	41.06	53.39	45.00	64.25	28.00	46.48	.	25.00	38.39	..
4 Lehigh,												
5 Northampton,												
6 Monroe												
7 Pike,												
8 Wayne,												
9 Susquehanna,	Silver Lake,	E. Rose,	39.78	55.26	47.68	70.00	29.00	47.57	.	27.00	37.55	..
10 Luzerne,												
11 Schuylkill,	Port Carbon	P. Carbon Lyceum,	37.19	56.19	40.96	76.00	18.50	44.78	5⅓	15.00	31.03	11
12 Berks,												
13 Chester,												
14 Delaware,	Haverford,	Haverford School,	53.50	54.91	51.46	64.00	37.00	53.29	20	25.00	38.20	21
15 Lancaster,	Lancaster,	Conservatory of Arts,	45.16	55.53	48.63	66.00	30.00	49.77	⅔	27.00	40.68	..
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	54.00	56.42	56.90	62.00	30.00	55.77	⅓	28.00	41.97	..
19 Northumberland.	Northumberland,	Andrew C. Huston,	41.55	52.80	46.49	61.00	28.00	46.95	.	20.00	33.52	..
20 Columbia,												
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Kinkead,	64.15	78.05	69.39	70.50	17.00	70.53	4⅓	......	......	..
27 Perry,												
28 Cumberland,	Carlisle	Prof. W. H. Allen,	62.87	71.65	64.42	67.00	21.00	66.31	.	19.00	38.03	..
29 Adams,	Gettysburg,	Prof. M. Jacobs,	61.11	70.39	69.94	66.00	25.00	67.15	.	23.50	38.25	..
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	46.97	49.60	49.61	67.00	27.00	48.73	⅓	......	......	..
32 Centre,	Bellefonte,	John Livingston,	51.39	63.00	59.36	67.00	20.00	57.92	3⅔	......	......	..
33 Potter,												
34 M'Kean,												
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	43.07	50.24	45.61	65.00	22.00	46.31	5	20.00	33.69	2
37 Bedford,	Bedford,	Samuel Brown,	53.32	54.55	54.78	68.00	23.00	54.22	⅔	......	......	..
38 Somerset,	Somerset,	George Mowry,	42.55	53.67	47.75	64.00	24.00	47.79	9⅔	20.00	32.96	8
39 Indiana,												
40 Jefferson,	Punxsutawny,	J. Smith	35.21	53.68	37.32	75.00	22.00	42.07	.	......	......	..
41 Warren,												
42 Venango,	Franklin,	Wm. Connely,	36.07	53.27	44.57	66.00	32.00	44.64	⅔	......	......	..
43 Armstrong,												
44 Westmoreland,												
45 Fayette,												
46 Green,												
47 Washington,												
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	43.93	54.96	47.18	64.00	38.00	48.69	4	26.00	59.30	1
49 Beaver,												
50 Butler,	Butler,	Jacob Mechling,	40.65	53.78	47.10	75.00	28.00	47.18	.	......	......	..
51 Mercer,												
52 Crawford,	Meadville,	Henry Shippen,	53.74	65.29	56.49	72.00	21.00	58.51	.	18.00	34.39	..
53 Erie,												

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers	Rain in inches.
1 Philadelphia,	30.09	30.07	30.12	30.51	29.49	30.09	6	21⅔	3⅔	6⅔	11	.....	.....	..	3.219
3 Bucks,	30.03	30.01	30.04	30.40	29.47	30.03	.	16⅓	13⅔	1	7	.....	.....	..	3.151
9 Susquehanna,	28.03	28.03	28.02	28.35	27.27	28.03	.	12⅓	18⅔	.	5	.....	.....	..	1.730
11 Schuylkill,	29.37	29.34	29.36	29.68	28.80	29.34	5⅔	11	14⅓	5⅔	5	.....	.....	..	1.433
14 Delaware,	29.46	29.47	29.46	29.87	28.91	29.46	19	6⅔	5⅓	19	.....	.....	.....	..	....
15 Lancaster,	29.53	29.52	29.51	29.90	28.93	29.52	⅔	16⅔	14	⅔	7	.....	.....	..	1.835
18 Dauphin,	29.77	29.76	29.75	30.12	29.26	29.76	⅓	.	.	.	8	.....	.....	..	1.267
19 Northumberland.	29.48	29.46	29.47	29.86	28.91	29.47	.	10⅓	20⅔	.	7	.....	.....	..	0.832
26 Juniata,	29.52	29.49	29.53	29.90	28.97	29.51	4⅓	11⅓	15⅓	4⅓	3	1	.....	..	0.112
28 Cumberland,	29.46	29.44	29.44	29.82	28.91	29.45	.	15	16	.	6	.....	.....	..	1.327
29 Adams,	29.41	29.40	29.42	29.77	28.91	29.41	.	16	15	.	8	.....	.....	..	1.561
31 Huntingdon,	29.39	29.37	29.38	29.70	28.78	29.38	⅓	17	14	.	4	1	.....	..	0.990
32 Centre,	29.29	29.30	29.28	29.91	28.07	29.29	3⅓	13⅔	13⅔	3⅔	3	.....	.....	..	0.950
36 Cambria,	27.85	27.84	27.83	28.13	27.40	27.84	4⅔	8⅔	17	5⅓	4	.....	.....	1	2.892
37 Bedford,	29.26	29.25	29.24	29.55	28.76	29.25	⅔	15	15⅓	⅔	.....	.....	.....	..	....
38 Somerset,	27.86	27.84	27.86	28.06	27.41	27.86	9⅔	8⅔	12⅔	9⅔	6	1	1	..	1.955
40 Jefferson,	28.99	28.99	29.02	29.30	28.50	29.00	.	.	.	.	3	.....	.....	..	1.440
42 Venango,	29.13	29.05	29.08	29.34	28.62	29.09	⅔	.	.	.	4	1	.....	..	1.491
48 Alleghany,	29.27	29.26	29.26	29.50	28.80	29.26	4⅓	7⅓	20⅓	3⅓	4	1	.....	..	1.967
50 Butler,	28.68	28.72	28.75	29.10	28.10	28.72	.	.	.	.	4	1	.....	..	1.185
52 Crawford,	28.79	28.80	28.80	29.05	28.33	28.80	.	12	19	.	10	2	1	..	2.394

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Dif. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	1⅓	.	1	.	.	.	.	.	⅔	⅓	5⅓	1	4	⅓	6⅓	1⅓	.	9⅓	....	.	.....	....	..	1750
3 Bucks,	1	⅓	1⅓	.	⅓	.	⅔	.	⅔	⅓	7⅔	1⅓	2⅔	1⅓	12⅓	⅓	.	⅔	....	.	.....	....	..	1613
9 Susquehanna,	2⅔	.	.	.	.	.	.	⅓	6	.	2⅓	.	7⅔	.	11⅓	⅔	.	.	....	.	.....	....	..	1624
11 Schuylkill,	⅔	.	2⅓	⅔	⅔	.	⅓	.	.	.	1	⅓	4⅓	1⅔	3⅓	.	10	5⅔	....	.	.....	....	..	1628
14 Delaware,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	.....	57.72	17	1610
15 Lancaster,	5⅔	1⅓	⅔	⅓	⅔	.	.	.	3	1⅓	4⅓	1⅔	2⅓	2⅔	3⅔	2⅔	.	⅔	42.39	1	.....	50.39	1	1640
18 Dauphin,	3⅓	.	⅔	.	⅓	.	6⅓	.	⅔	.	1⅔	.	6⅔	.	11	.	.	⅓	....	.	.....	....	..	1602
19 Northumberland.	6	.	1⅓	.	1	.	1⅔	⅓	4	⅓	1⅔	.	4⅔	.	4⅓	.	5⅔	.	....	.	.....	53.23	1	1612
26 Juniata,	.	.	2	.	.	.	1	.	⅓	.	1⅓	.	1⅔	.	5⅓	.	14⅓	5	....	.	.....	....	..	1609
28 Cumberland,	1	1	1⅓	.	.	.	⅓	.	2⅓	.	2	.	7⅔	⅔	7⅓	1	6⅓	.	....	.	.....	....	..	1618
29 Adams,	1	1	1⅔	.	.	.	.	.	1⅔	2⅔	8⅔	1⅓	2⅓	1⅓	8⅓	1	.	.	42.12	.	.....	48.21	..	1654
31 Huntingdon,	.	.	.	.	10⅔	.	.	.	.	.	.	.	20	.	.	.	.	⅓	....	.	.....	....	..	1629
32 Centre,	4⅔	⅓	2⅓	.	.	.	.	.	3⅓	.	3⅓	⅓	3	.	4⅓	.	.	9⅓	....	.	.....	....	..	1611
36 Cambria,	3⅓	.	1⅓	.	.	.	2	.	⅓	.	2⅔	.	8	.	8⅔	.	.	4⅔	....	.	.....	....	..	1514
37 Bedford,	⅔	.	1	.	.	.	3⅔	.	.	⅓	7⅓	⅓	1⅓	8⅓	7⅓	.	.	⅔	....	.	.....	....	..	1516
38 Somerset,	1⅔	.	⅔	.	1	.	.	.	1⅓	.	2⅔	.	3	1⅓	1	.	8⅔	9⅔	....	.	.....	48.24	10	1521
40 Jefferson,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	.....	....	..	1626
42 Venango,	.	.	1	.	.	.	3⅓	.	.	.	3⅓	.	.	.	22⅔	.	.	⅔	....	.	.....	....	..	1737
48 Alleghany,	⅔	⅓	⅔	.	1⅓	⅓	2⅓	.	⅓	.	1⅓	.	⅔	.	8⅔	1	9⅔	3⅔	....	.	.....	....	..	1515
50 Butler,	.	.	2	.	6⅓	.	1⅓	.	.	.	6⅓	.	13⅓	.	1⅔	.	.	.	....	.	.....	....	..	1622
52 Crawford,	4	.	2⅓	.	⅔	.	1	.	6⅓	.	1⅓	.	⅔	.	1⅔	.	12⅓	⅔	....	.	.....	....	..	1617

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		Maximum.		W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1	Philac	30.58												
2	Mont													
3	Bucks	30.48		$\frac{1}{3}$	4	$1\frac{1}{3}$	.	$7\frac{1}{3}$	....	.	.....	....	..	1782
4	Lehig													
5	North			$1\frac{1}{3}$	$9\frac{2}{3}$	.	.	2	....	.	.....	....	..	1718
6	Monr	29.88	2											
7	Pike,													
8	Wayn			.	$\frac{2}{3}$	.	.	$23\frac{1}{3}$	....	.	.....	....	..	1651
9	Susqu	28.30	2											
10	Luzer													
11	Schuy	29.73	2		$8\frac{1}{3}$	.	.	.	....	.	.....	....	..	1652
12	Berks													
13	Chest			.	6	.	$7\frac{1}{3}$	$1\frac{1}{3}$	....	.	.....	....	..	1667
14	Delaw	29.94	2											
15	Lanc	29.96	2											
16	York,			$\frac{1}{3}$	$\frac{2}{3}$	1	$\frac{1}{3}$	$16\frac{1}{3}$	....	.	.....	....	..	1642
17	Lebar			$\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{2}{3}$	.	$\frac{1}{3}$	37.26	1	.....	42.76	1	1657
18	Daup	30.17	2											
19	North	29.88	2											
20	Colur				$14\frac{2}{3}$	.	.	$\frac{1}{3}$	....	.	.....	....	..	1630
21	Bradf			$\frac{1}{3}$	4	$\frac{1}{3}$	$2\frac{2}{3}$	.	....	.	.....	....	..	1631
22	Tioga													
23	Lycor													
24	Union													
25	Miffli													
26	Junia													
27	Perry													
28	Cumb	29.82	28											
29	Adam	29.74	28											
30	Frank				$8\frac{2}{3}$	.	$6\frac{1}{3}$	$1\frac{1}{3}$	....	.	.....	....	..	1649
31	Hunt	29.73	28		$3\frac{2}{3}$	1	$3\frac{1}{3}$	$\frac{2}{3}$	35.47	8	.....	42.94	7	1655
32	Centr	29.69	28											
33	Potte				.	.	.	1	....	.	.....	....	..	1656
34	M'Ke				$9\frac{2}{3}$	.	.	$2\frac{1}{3}$	....	.	.....	....	..	1640
35	Clear													
36	Camb	28.10	27											
37	Bedfo	29.55	28		$4\frac{1}{3}$	.	$\frac{1}{3}$	$2\frac{1}{3}$	....	.	.....	....	..	1647
38	Some													
39	Indiar				$6\frac{1}{3}$	.	.	$\frac{1}{3}$	....	.	.....	....	..	1632
40	Jeffer	29.20	28.											
41	Warr													
42	Venan	29.60	28.		.	.	.	.	....	.	.....	....	..	1658
43	Arms													
44	West				$15\frac{2}{3}$	.	.	.	....	.	.....	....	..	1646
45	Fayet													
46	Green													
47	Wash													
48	Alleg	29.52	28.											
49	Beave													
50	Butle	29.10	28.		$7\frac{1}{3}$	.	$10\frac{1}{3}$	1	....	.	.....	....	..	1637
51	Merce													
52	Craw	29.05	28.			.	.	.	....	.	.....	....	..	1644
53	Erie,				$\frac{1}{3}$	.	$9\frac{1}{3}$	1	....	.	.....	...	..	1641

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METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA.
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
NOVEMBER, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1 Philadelphia,	Philadelphia,	E. W. Hamilton,	39.07	51.85	45.80	80.00	22.00	45.57	4¾	14.00	34.52	3
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	35.53	44.31	37.67	72.00	18.00	39.17	⅓	15.50	32.08	..
4 Lehigh,												
5 Northampton,												
6 Monroe,	Stroudsburgh,	A. M. Stokes,	35.36	47.00	37.50	65.00	19.00	39.95	22	......	......	..
7 Pike,												
8 Wayne,												
9 Susquehanna,	Silver Lake,	E. Rose,	36.33	45.17	39.77	70.00	16.00	40.42	.	16.00	34.40	..
10 Luzerne,												
11 Schuylkill,	Port Carbon,	P. Carbon Lyceum,	35.10	44.67	36.50	66.00	18.50	38.76	1⅓	17.00	30.88	1
12 Berks,												
13 Chester,												
14 Delaware,	Haverford,	Haverford School,	38.43	51.19	49.73	64.09	20.00	46.45	1	16.00	33.79	2
15 Lancaster,	Lancaster,	Conservatory of Arts,	38.15	46.59	39.48	72.00	17.00	41.41	⅓	16.00	35.35	..
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	40.33	43.83	42.50	64.00	26.00	42.22	⅓	24.00	37.00	..
19 Northumberland,	Northumberland,	Andrew C. Houston,	36.93	44.17	38.57	69.00	20.00	39.89	.	16.00	32.40	..
20 Columbia,												
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,												
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,	35.70	45.14	38.14	70.00	19.00	39.66	1⅓	18.00	32.70	..
29 Adams,	Gettysburg,	Prof. M. Jacobs,	36.97	45.31	39.17	67.00	19.00	40.48	.	19.00	35.27	..
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	35.07	46.21	40.43	74.00	22.00	40.27	1	......	......	..
32 Centre,	Bellefonte,	John Livingston,	37.02	45.73	39.27	72.00	22.00	40.67	.	......	......	..
33 Potter,												
34 M'Kean,												
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	31.83	38.40	32.14	68.00	14.00	34.12	2⅓	14.00	29.90	..
37 Bedford,	Bedford,	Samuel Brown,	35.95	45.60	39.28	72.50	14.00	40.28	⅓	......	......	..
38 Somerset,												
39 Indiana,												
40 Jefferson,	Ponxsutawny,	J. Smith,	29.57	42.03	31.67	75.00	17.00	34.42	.	......	......	..
41 Warren,												
42 Venango,	Franklin,	Wm. Connely,	34.63	44.57	37.20	74.00	32.00	38.80	.	......	......	..
43 Armstrong,												
44 Westmoreland,												
45 Fayette,												
46 Green,												
47 Washington,												
48 Allegheny,	Pittsburgh,	J. P. Bakewell,	46.55	45.74	48.07	70.00	35.00	46.79	1⅓	25.00	37.00	1
49 Beaver,												
50 Butler,	Butler,	Jacob Mechling,	40.00	44.07	40.33	79.00	26.00	41.47	.	......	......	..
51 Mercer,												
52 Crawford,	Meadville,	Henry Shippen,	34.43	40.73	33.97	72.00	21.00	36.38	.	22.00	33.00	..
53 Erie.												

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	30.05	29.93	30.01	30.58	29.59	30.00	3¾	19⅓	7	3¾	13	4	......	..	4.041
3 Bucks,	29.93	29.90	29.92	30.48	29.44	29.92	⅓	12⅓	15	2¾	12	4	......	..	3.773
6 Monroe,	29.53	29.58	29.72	29.88	29.20	29.61	22¾	2¾	4⅓	23	......	......	......	......	......
9 Susquehanna,	27.95	27.95	27.94	28.30	27.51	27.95	.	5	25	.	2	4	......	......	......
11 Schuylkill,	29.25	29.20	29.25	29.73	28.80	29.23	1¾	7⅓	20¾	2	7	4	1	.	2.294
14 Delaware,	29.42	29.38	29.40	29.94	28.96	29.40	1⅓	11	17¾	1⅓	11	2	......	..	4.256
15 Lancaster,	29.44	29.40	29.42	29.96	28.90	29.42	⅓	13¾	16	⅓	8	5	......	..	3.127
18 Dauphin,	29.61	29.68	29.69	30.17	29.31	29.66	½	.	.	.	9	2	1	..	......
19 Northumberland,	29.37	29.34	29.37	29.88	28.90	29.36	.	5¾	24⅓	.	8	2	1	..	2.412
28 Cumberland,	29.33	29.33	29.33	29.82	28.87	29.33	1⅓	6	22¾	1⅓	6	5	......	..	3.052
29 Adams,	29.32	29.28	29.31	29.74	28.83	29.30	.	9⅓	20¾	.	8	3	4	..	3.725
31 Huntingdon,	29.26	29.32	29.30	29.73	28.82	29.29	1	8⅓	20¾	1	9	3	......	..	2.377
32 Centre,	29.10	29.12	29.16	29.69	28.00	29.13	.	5	25	.	7	2	1	..	3.173
36 Cambria,	27.73	27.74	27.75	28.10	27.38	27.74	2⅓	4	23¾	2⅓	7	4	......	1	3.369
37 Bedford,	29.15	29.12	29.13	29.55	28.80	29.13	⅓	7	22¾	⅓	......	......	......	......	......
40 Jefferson,	28.87	28.82	28.84	29.20	28.40	28.84	.	5¾	15¾	8¾	8	8	1	..	......
42 Venango,	29.02	29.03	29.04	29.60	28.52	29.03	.	.	.	.	7	5	......	..	2.072
48 Allegheny,	29.15	29.15	29.16	29.52	28.65	29.15	1	4¾	24⅓	1	8	......	......	..	2.764
50 Butler,	28.72	28.72	28.72	29.10	28.30	28.72	.	.	.	.	5	3	3	1	3.615
52 Crawford,	28.64	28.66	28.65	29.05	28.20	28.65	.	4	24⅓	1¾	5	3	......	2	3.230

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	2	.	3¾	⅓	¾	.	⅓	¾	1	.	2¾	.	5⅓	⅓	4	1⅓	.	7½	....	.	.....	...	..	1732
3 Bucks,	1⅓	.	4⅓	⅓	.	⅓	¾	¾	.	1	¼	1	3⅓	1⅓	9¾	.	.	2	....	.	.....	....	..	1718
6 Monroe,	½	.	¾	.	1	.	⅓	.	.	.	¾	.	3	.	¾	.	.	23½	....	.	.....	....	..	1551
9 Susquehanna,	5	.	4	.	.	.	.	.	4	.	2¾	.	5½		5½	.	.	.	....	.	.....	....	.	1550
11 Schuylkill,	⅓	.	2	.	2	.	3	.	¾	.	3	.	4	.	6	.	7½	1½	....	.	.....	....	..	1567
14 Delaware,	4⅓	⅓	1⅓	¾	.	.	.	.	⅓	⅓	[illegible]	¾	3		¾	1	⅓	16½	....	.	.....	....	..	1542
15 Lancaster,	3⅓	1⅓	2⅓	1	¾	⅓	[illegible]	⅓	3	1	2[illegible]	3	3	4	1⅓	1¾	.	⅓	37.25	1	.....	42.75	1	1557
18 Dauphin,	1	.	2	.	3	.	3⅓	.	.	.	1	.	4¾	.	14¾	.	.	⅓	....	.	...	...	..	153[illegible]
19 Northumberland,	3⅓	.	2¾	.	2½	.	2	⅓	4	.	1¾	.	6½		4	⅓	2¾	.	....	.	.....	....	..	1521
28 Cumberland,	1⅓	.	1¾	.	1	.	1	⅓	1¾	⅓	4	.	3	.	8¾	.	6⅓	1⅓	....	.	.....	....	.	1543
29 Adams,	¾	⅓	2¾	1⅓	.	¾	.	.	2¾	2⅓	1⅓	1	6⅓	2	3¾	1	3⅓	¾	35.47	8	.....	42.84	.	1555
31 Huntingdon,	.	.	.	.	8⅓	.	.	.	.	.	.	.	20¾	.	.	.	.	1	....	.	.....	....	..	1556
32 Centre,	4	.	1	.	⅓	.	⅓	.	2¾	.	3	.	6¾	.	9¾	.	.	2⅓	....	.	.....	...	.	1546
36 Cambria,	.	.	.	.	5	.	2	.	⅓	.	1¾	⅓	13	¾	4⅓	.	⅓	2⅓	....	.	.....	...	..	1547
37 Bedford,	.	.	⅓	.	2	.	2⅓	.	2⅓	.	7	⅓	1¾	7	6⅓	.	.	⅓	....	.	...	....	..	1532
40 Jefferson,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	.....	....	..	1555
42 Venango,	.	.	.	.	.	.	5	.	.	.	9⅓	.	.	.	15¾	.	.	.	....	.	.....	....	..	1645
48 Allegheny,	.	.	1	⅓	1	¾	3⅓	.	⅓	.	1	.	2	1¾	7⅓	.	10⅓	1	....	.	.....	....	..	1537
50 Butler,	.	.	⅓	.	7¾	.	2¾	.	¾	.	6	.	12¾	.	.	.	.	.	....	.	.....	....		1544
52 Crawford,	1¾	.	1	.	1¾	.	1¾	.	8¾	.	¾	.	4	.	⅓	.	9⅓	1	....	.	.....	...	..	1542

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JUNE, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

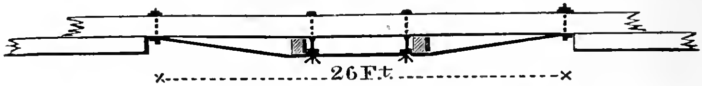
Details of some Experiments upon the Comparative Strength of Trussed and plain girders of wood, made at the Philadelphia Exchange, during the construction of that building in 1832. *By* Mr. John McClure and Ellwood Morris, C. E. *Reported by the latter.*

The experiments which have been made upon the relative strength of girders, trussed and untrussed, are so few—that the following details may be found interesting to persons engaged in construction; particularly as the mode of trussing by suspension, therein tested, is becoming more and more extensively used in this country, and is really susceptible of being made very serviceable in many situations.

These experiments were undertaken with the view of ascertaining the proximate value of wrought iron suspension trusses for girders, which were about that time brought forward conspicuously here, as a new and useful improvement in carpentry; though at least in one instance they had been used many years before in this country; viz., by Lewis Wernwag, the celebrated carpenter,* who applied suspension bars, one and a quarter inches square, to stiffen the main longitudinal floor beams of the bridge over the Neshaminy creek, in this state, which was built by him in the year 1808. (See the annexed sketch

* Mr. Wernwag, a German by birth, immigrated here in 1788, and is the same mechanic who designed and constructed the famous timber bridge of 340 feet span, over the Schuylkill river at Philadelphia, (recently destroyed by fire,) besides many other wooden bridges of magnitude and importance, in various parts of the United States.

which represents a side view of the suspension truss used in the bridge referred to.)



We have taken the pains to ascertain from Mr. Wernwag himself, the date of the construction of the Neshaminy bridge, as it carries the application of the suspension girder truss somewhat further back into past time, than has heretofore been expected; though the writer has lately been informed by a gentleman distinguished for his antiquarian researches, that such trusses were in use upon the continent of Europe even antecedent to that time.

The now recorded history of the wrought iron suspension truss for girders, as far as known to the writer, is as follows:—"In 1821, Mr. R. Stevenson, of Edinburgh, designed a bridge for the river Almond, in which the principle of supporting a roadway by iron bars passing underneath, was first adopted."* In 1822 the same principle was recommended by Mr. H. Palmer, to be applied in carrying his railway, of a single line, over streams or vallies.† In 1824 Mr. A. Ainger submitted a suspension trussed girder to the Society for the encouragement of Arts;‡ to which we shall presently more particularly refer, and which was successfully applied to practice. In 1828 girders trussed by suspending rods were used with manifest advantage in several buildings, by Mr. Joseph Conder, who claimed the merit of their invention, as did also Mr. A. H. Renton, Civil Engineer.‖ All these gentlemen, however, without their knowledge, had been anticipated in this matter by Wernwag, at the Neshaminy bridge, as before mentioned.

In addition to the above, the writer may state that in 1833 he examined a wrought iron suspension truss, which had been applied some years before, on a large scale, to uphold the central parts of Flat Rock bridge, (of 198 feet span,) over the Schuylkill river; which bridge—constructed with *very slender* curved ribs of three inch plank—had at that time yielded considerably, and since has fallen down. In 1834 he measured a horse bridge (built by Wernwag) upon the Chesapeake and Ohio Canal, near Harper's Ferry, of 52 feet span, which was trussed like fig. 1, the horizontal bar being 26 inches clear of the underside of the outer floor beams, which rested each upon two inverted queen posts of iron, diagonally braced against lateral motion,

* Civ. Eng. & Arch. Jour., for Oct., 1841. "Description of the Foot Bridge over the river Whitadder, at Abbey St. Bathans, Berwickshire; by J. R. Wilson."

† Palmer's "Description of a railway on a new principle," London.

‡ Journal of the Franklin Institute for 1832. ‖ Reg. of Arts, 2nd series, vol. ii, London.

and rising, as it were, from the angular points *b* and *c*. This species of truss has, since that time, been applied to strengthen the girders of a number of bridges in this country, to which it is unnecessary now to refer.*

Returning from this digression, into the recent history of suspension trussing; we will now repeat, that in this Journal for August, 1832, the description of a mode of trussing girders with wrought iron rods, acting upon the suspension principle, was extracted from the "Transactions of the Society for the encouragement of Arts," and accompanied by two wood engravings.

The plan alluded to was devised by Mr. Alfred Ainger, and submitted to the Society in 1824, who after investigating the merits of the plan—trying some experiments upon models—and witnessing its successful application in buildings—finally testified to Mr. Ainger, their sense of the merit of his contrivance for strengthening beams, by formally awarding to him the thanks of the Society.

Mr. Ainger's suspension truss, as applied to a girder of 34 feet span, and described in this Journal for 1832, consisted of two sets of iron rods, (one on each side of a single beam of timber,) secured by screws and nuts, to abutment plates, notched upon *the upper side* at the ends: these rods descended so low as to admit of two supporting plates being inserted between them and the beam, and forced up against its underside by the end screws, so as to give to the girder two intermediate points of support; thus dividing the whole span into three bearing spaces of equal extent; the side view closely resembling fig. 1.

This girder is described as having answered very well, it is stated to have carried a leaden flat for two years, without sensibly altering its form.

Mr. Ainger also recommended that notches should be cut in the upper side of the beam extending to one-third of its depth, and filled "with thin wedges of hard wood or metal, forcibly driven in," so as to augment its strength and stiffness, by putting its upper side in a state of compression before being loaded.†

* In connexion with this branch of the subject, we must not omit to add the following, from the same paper of Mr. J. R. Wilson, (Civ. Eng. & Arch. Jour., Oct, 1841,) already quoted.

"In 1833 a bridge was erected on the tension bar principle over an arm of the lake of Geneva. It has 13 openings, of 55 feet span, and is 25 feet broad. The same plan has been adopted for two foot bridges of 138 and 81 feet span respectively, erected several years since over the river Ness, near Inverness; and also for a bridge over the river Whitadder, in Berwickshire, at Hutton Mill, designed by Mr. Jardine, of Edinburgh, which consists of three openings of 50 feet span. Mr. Smith, of Deanston, has erected a foot bridge of this kind, 103 feet span, near Doune: and has also applied tension rods very successfully, for supporting the floors of Deanston cotton works, where they have been in use for many years."

† This was conformable to the results of some experiment by M. Duhamel, who showed

It was the article above referred to which first drew the attention of the writer to this particular subject, and induced him, in company with Mr. McClure, to undertake, in the year 1832, a few experiments upon model girders.

These models were accurately made under the direction of Mr. McClure, and were *five in number;* each was composed of two parts, or flitches, so united as to bear a strain together; each side, or flitch, was 53 inches long, 1.75 inches deep, and 1.16 inches broad, having together a sectional area of 4.06 superficial inches; and all the models were made of clean, straight grained, and well seasoned *white pine;** number 1, 2, and 3, were from the same plank, and Nos. 4 and 5 from timber of the same lot and quality.

Model No. 1: Was trussed in a mode similar to that prescribed by Mr. Ainger; a single wrought iron rod exactly one-fourth of an inch square, being secured upon the upper side, at both ends, by quarter inch square pins, resting horizontally upon abutment plates one-twelfth of an inch thick, which embraced each end of the girder; this rod descended between the flitches so low as to admit the insertion of two bearing plates, *b* and *c*, fig. 1, which were forced in between it and the underside of the beams, at equal distances from the ends, and from each other, so as to give to the girder a small camber. (See plan and section, fig 1.) And, in addition, 34 equidistant cuts were made in this model, to a depth of one-third of the whole, and tightly filled with thin pieces of hard oak well driven in.

Model No. 2: Was similar to No. 1, (fig. 1,) in all respects except that the hard oak wedges were *omitted.*

Model No. 3: Was a plain stick, formed by nailing the two flitches

that when a bar of *soft wood,* such as willow, was cut one third through from the upper side, and this cut filled with a thin piece of *hard wood* stuck in pretty tight, *its ultimate transverse strength was thereby increased about ten per cent.,* (Barlow's Essay on the Strength and Stress of Timber, 3rd Ed., 1826.)

* This is the *Pinus Strobus* of Michaux's North American Sylva (vol. iii, p. 159)—the loftiest tree of the American forest—it is employed here for an immense variety of purposes, and is one of the most valuable timbers which we possess.

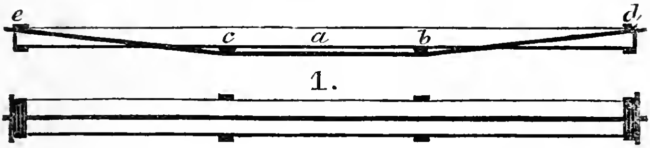
It is the wood called *Weymouth Pine,* in Tredgold's Carpentry; and we may here remark that the concurrence of three of our experiments indicates that the ultimate strength of the white pine, used in our models—which was of the best quality supplied by the lumber market of Philadelphia—did not exceed 868 lbs., for sticks of the scantling, and length of bearing, used by us.

Wherefore the constant quantity *c*, of the table in Tredgold's Carpentry, (2nd Ed., London, 1828, p. 56,) calculated by the formula $c=\frac{W\,L}{b\,d^2}$ would be 509 instead of 658, as Tredgold has it, which last is certainly too high a number; for the breaking weight of our plain stick, (model No. 3,) if calculated by it, would have been 1,122 lbs., instead of 868 lbs., (as we actually found it to be,) *or thirty per cent. more.*

together, side by side, with four nails in the centre line, (see fig. 2, side view.)

Model No. 4: Was a girder trussed exactly like Nos. 1 and 2, except that *a central bearing plate*, one-sixteenth of an inch thick, was inserted between the beam and truss rod at *a*, fig 1.

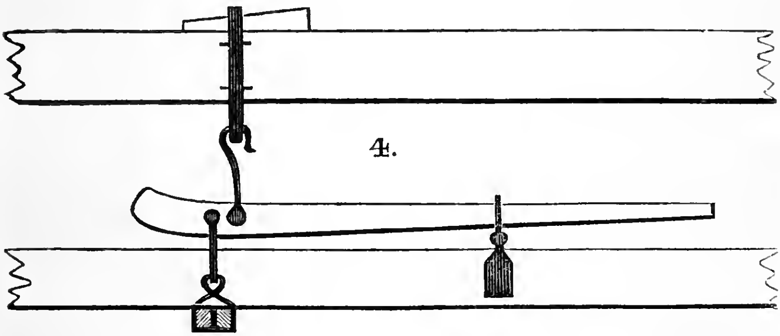
Model No. 5: Was a girder trussed in the common way—with one king bolt, two iron abutments, two hard oak braces let into each flitch nearly one eighth of an inch—and keyed up to a slight camber. (See fig. 3, which shows the girder with one flitch removed.)



1.

2.

3.



4.

All of these models were put under strain in the same manner, their own weight being counterbalanced; viz., by resting them against two fixed supports, exactly 50 inches asunder, and applying the straining force, by a vertical pull upwards, through an iron stirrup with rounded edges, slipped over the model—which was turned bottom up—and attached to the shorter arm of an accurate steelyard, which weighed up to 1,288 lbs.; and the successive strains were put on by moving the pea of the steelyard, as in weighing, so as to add usually 56 lbs.

at a time; the beam of the steelyard being adjusted to a level at each addition of strain, and the deflections being carefully measured—from a fine string joining the extremities of the models—by a diagonal scale to hundredths of inches. (See fig. 4, which gives a general idea of the experimental apparatus, *f* being a girder under trial.)

The subjoined tabular statement exhibits, at one view, the results of the trials of the strength of the several model girders; which it will be recollected, were all of precisely the same scantling and bearing length.

It must be observed that our steelyard not having sufficient power to break model No. 4, it was subsequently broken by a lever, in order to ascertain the position of *the neutral axis of fracture.*

The five following results were common to all the models when broken, and though similar to what have been observed by other experimentalists, they may as well be stated.

1. *The neutral axis of fracture*, occupied precisely the same place

Statements.	Weight applied in pounds.	Girder No. 1. Trussed with iron rod, and wedged along compressed side. See fig. 1.		Girder No. 2. Trussed with iron rod, but without the wedges of No. 1. See fig. 1.		Girder No. 3. Plain stick without trusses. See fig. 2.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c.20	Original camber .31ins	c.15	Original camber .20ins	.09	Original camber .0 ins.
2	112	c.06	Stood level with 140lbs	c.09	Cambers marked c.	.16	
3	168	.09		.00	Stood level with 168lbs	.27	
4	224	.22		.04		.37	
5	280	.40		.12		.47	
6	336	.55	364 lbs. remaining on for 10 minutes, increased the deflection	.19		.57	
7	392	.80	.12 ins.	.28		.65	
8	448	.94	At 8 unloaded returned	.37		.75	
9	504	1.13	to a camber of .10.	.47	At 9 unloaded returned	.83	At 9 unloaded returned
10	560	1.40	532 lbs. remaining on 5 minutes increased the deflection from 1.27 to 1.32 = 0.15 ins.	.64	to a camber of .12ins	.93	Ditto. [to level.
11	616	1.68	At 11 unloaded return-	.77		1.07	
12	672	1.98	ed to a deflection of	.89	Upper fibres begin to	1.19	Upper fibres begin to
13	728	2.21	.18 ins.	1.00	crush.	1.35	crush..
14	784	2.50		1.20	Appearance of crush-	1.51	Crushing fast increas-
15	840	2.80		1.50	ing extends rapidly.	1.76	ed.
16	868	3.00	Broke with 868lbs. (or	1.75	Broke with 868lbs. (or	2.50	Broke with 868lbs. (or
17	896		7 cwt. 3 qrs.) ulti-		7 cwt. 3 qrs.) ulti-		7 cwt. 3 qrs.) ulti-
18	952		mate deflection 3		mate deflection 1¾		mate deflection 2½
19	1008		inches.		inches.		inches.
20	1064						
21	1120						
22	1176						
23	1232						
24	1288						

in all, being at four-sevenths of the whole depth down from the top, or one fourteenth below the middle, (Barlow's experiments on *fir beams* fixed it at five-eighths of the depth, which is nearly the same.)

Giving, area of fibres *crushed*,	2.32	square inches.
Ditto *torn asunder*	1.74	"
Total sectional area in superficial inches	4.06	

2. The first indications of fracture, always appeared on the upper side, by the fibres *crushing*.

3. The signs of crushing at the time of fracture could be traced each way from the centre some five or six inches.

4. The deflections within the limit of elasticity, were (very nearly) equally increased by the addition of equal weights.

5. The place of the neutral axis of fracture, was most distinctly marked in every case, and the section of fracture, in all the models,

Statements.	Weight applied in pounds.	GIRDER No. 4. Trussed like Nos. 1 and 2, but with the addition of a *centre plate* at *a*. See fig. 1.		GIRDER No. 5. Trussed with wood in the common way. See fig. 3.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c.14	Original camber .19 inches.	.05	Original camber .05 inches.
2	112	c.09	Cambers marked *c*.	.10	Stood level with 28 lbs.
3	168	c.05		.17	
4	224	.00	Stood level with 224 lbs.	.25	
5	280	.04		.32	
6	336	.08		.41	
7	392	.14		.47	
8	448	.21		.55	
9	504	.29	At 9 unloaded returned to the ori-	.64	
10	560	.37	ginal camber.	.71	
11	616	.46		.79	At 11 unloaded returned to level.
12	672	.53		.95	
13	728	.61		1.02	
14	784	.69		1.12	At 14 unloaded returned to level.
15	840	.77		1.18	
16	868	.82	At 16 (the breaking point of Nos.	1.25	
17	896	.87	1, 2, and 3,) unloaded returned	1.46	At 17 considerable signs of crush-
18	952	.92	to a camber of .08 ins., and exhi-	1.61	ing appear.
			bited no signs of fracture.		
19	1008	1.00	At 19 unloaded returned to a slight	1.76	
20	1064	1.10	camber, though signs of crushing	2.07	At 20, splinters on the underside.
21	1120	1.21	begin to appear.	2.50	Weights briskly added, fracture
22	1176	1.40		3.00	takes place at 22, ultimate de-
23	1232	1.56	Signs of crushing increase.		flection 3 ins. Breaking weight
24	1288	1.75	Rested here for want of weight,		=10½ cwt.
			and unloaded returned to a per-		
			manent deflection of .16 ins.		

very closely resembled that shown in Plate III of Barlow's Essay on Timber, 3rd ed: London, 1826.

The elastic strength of Model	No. 1,	did not exceed	392 lbs.
do.	No. 2,	do.	560
do.	No. 3,	do.	560
do.	No. 4,	do.	1120
do.	No. 5,	do.	840

As indicated by the breaking weights, excepting only No. 4, which would have borne a few more pounds; and No. 5, which would have broken with less, *if time* had been allowed.

The ultimate strength of Model	No. 1,	was	868 lbs.
do.	No. 2,	"	868
do.	No. 3,	"	868
do.	No. 4,	"	1288+
do.	No. 5,	"	1176—

A comparison of the tabular results will show:

1. That, contrary to the experiments of Duhamel, wedging the stick upon the upper side to one-third of the depth, with slips of hard wood—at least in the extent to which we carried it—neither augmented nor impaired *the ultimate strength* of the timber, while it diminished its *stiffness*.

2. That the suspension truss, though it added to the *stiffness*, had no effect whatever, upon the *ultimate strength*, when only *two bearing plates*, (as *b* and *c*, Fig. 1,) were used, and the weight applied midway between them.

The reason of this appeared to be, that the deflection between the bearing plates, when added to the compression of the timber, at these, and at the abutments, allowed the beams to bend enough to exceed the deflection due to their elastic strength, before the suspension truss came fairly into action.

3. That the suspension truss, *with a centre plate* applied at *a*, Fig. 1, *doubled the elastic strength* of a plain girder of the stated dimensions, *and added near fifty per cent. to its ultimate strength.*

4. That trussing a girder with hard wood, in the usual manner, increased its *elastic strength* fifty per cent., and its *ultimate strength* about thirty-five per cent.

This last conclusion is nearly the same as that developed by Professor Barlow, in experimenting upon a similar truss. (See Treatise on the Strength of Materials: London, 1837, page 165.)

The experiments referred to, and of which we subjoin a synopsis, showed that though there was no efficacy at all, in a common girder truss, *of three pieces of hard wood, with queen bolts*,—indeed, that it was weaker than an untrussed stick,—still, the truss of *two pieces,*

with a king bolt, similar to that of Fig. 3, *did add considerably to the strength.*

Synopsis of Barlow's Experiments on the Strength of Girders of Wood.

No. of Experiment.	Distance betw'n the Props, in inches.	Depth of the Girder, in inches.	Breadth of the Girder, in inches.	Ultimate weight imposed, in pounds.	Ultimate deflection, in inches.	REMARKS.
1	68	2	$1\frac{7}{8}$	500	2.25	*Trussed*—not broken.
2	68	2	$1\frac{7}{8}$	500	1.55	*Untrussed*—not broken.
3	50	2	$1\frac{7}{8}$	953	+1.50	*Trussed*—broken.
4	50	2	$1\frac{7}{8}$	717	+1.00	*Untrussed*—broken.

Nos. 1 and 3 were trussed conformably to Plate 39 of Nicholson's Carpenters' New Guide, the former being a model of a girder of thirty-four, and the latter of twenty-five, feet span.

No. 1 was *a queen bolt truss, of three pieces;* No. 3 was *a king bolt truss of two pieces,* similar to Fig. 3, and the weights were applied in the centre, or over the angular point of the latter truss, and midway between the queen bolts of the former.

Hence it appears that whilst the queen bolt truss, No. 1, was actually weaker than the untrussed stick No. 2, the king bolt truss No. 3 was *thirty-three per cent. stronger* than the untrussed stick No. 4, of the same dimensions, and similarly strained.

Our experiments on model No. 5, which was trussed nearly in the same manner as Barlow's No. 3, display *an augmentation of strength of thirty-five per cent.* over that of an untrussed beam.

The close agreement of our results with those of Barlow, probably justifies the declaration that—at least whilst they are new—*the common wooden king bolt trusses, add one-third to the strength of the girders to which they are applied.*

Tredgold, however, in his invaluable treatise upon Carpentry, (2d Ed., London, 1828, p. 79,) says that "The methods in general adopted, (for trussing girders,) have the appearance of much ingenuity, but in reality they are of very little use." And again,—"The defects of ordinary trussed girders are very apparent in old ones, as it is not simply strength that is required, but the power of resisting the

unceasing concussions of a straining force, capable of producing a permanent derangement in a small surface at every impression."

As the tendency of time is undoubtedly to impair the efficiency of all sorts of trussing, and especially of those which—like girders trussed within their own depth—have *very obtuse supporting angles;* more extended experiments, and further observations, are necessary to settle definitively the question of strength, between beams trussed within themselves with timber, and plain sticks of the same bearing, and scantling.

In 1828, Mr. J. Conder, soon after applying in practice the suspension truss *of two angular points,* (see Fig. 1,) seems to have become satisfied that it was defective; for he soon brought forward, as a great improvement, the idea of forming the truss with but *one angular point,* like Fig. 3, inverted; and it will be remembered, that in our experiments we were unable to procure any benefit from the suspension truss, until by the central bearing plate at *a,* Fig. 1, we had, *in effect,* reduced that truss to one of *a single angular point.*

In trussing a girder, the main object is to strengthen the weakest point—which is the centre of the beam—and as Barlow's experiments upon direct *queen bolt trusses,* and our own, upon inverted, or suspension trusses, *of two angular points,* indicated that no advantage was derived from either, when strained in the middle, we are strongly disposed to conclude, that whether the truss acts by tension or by compression, it should (in most cases,) *have but one angular point.*

In support of this view, the writer may state that he has seen a number of suspension trusses of two angular points,—attached to the girders of bridges,—which, on close examination, indicated that they bore but little strain; whilst those with but one angular point, which he has had an opportunity of examining, seemed, in most cases, to be acting with much greater efficiency; this matter therefore seems to be of sufficient importance to justify our soliciting to it, the attention and consideration of professional men.

Philadelphia, April 28th, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Injudicious Policy pursued in the Construction and Machinery of many Railroads in the United States. By JOHN C. TRAUTWINE, *Civil Engineer.*

[CONTINUED FROM PAGE 316.]

The argument is not admissible, that perhaps in ten or fifteen years, the business of the road may increase to such an extent as to pay a profit on its cost. If the engineer wishes to ascertain if this be ac-

ceptable reasoning, let him suggest it to the stockholders before the road is commenced, and I suspect he will find but few to acquiesce with him.

But I see the sceptical reader elevate his eyes in astonishment. "What," says he, "the old flat bar! light engines! heavy grades! Is it possible the writer expects his readers to subscribe to so antiquated and exploded a creed as this? Even supposing his road to answer very well at first, with the limited business assigned to it, what will be done with it when the trade increases? *Ours* is a growing country, and the present business is no criterion to act on: in a few years it will have increased fifty, nay, a hundred per cent.; what is to be done then?"

The answer readily suggests itself: if the business increases 100 per cent., put on four engines instead of two. "But, ah!" says the objector, "there I have you. Don't you know that one heavy engine will draw a given amount of freight at less expense than a greater number of light ones can?" I most assuredly do know this to be true in the abstract; and I know, moreover, that a blind adherence to this "abstraction," has nearly ruined more railroad companies than one, in the United States. Let us illustrate this, also, by an example. Suppose our $ 10,000 a mile road to be finished, and in operation; its little models daily steaming it modestly over the line, with their thirty tons gross; and the stockholders annually pocketing their eight per cent. "net." This all does very well for a time; but "ours is a growing country," and soon the business on our road increases one hundred per cent. What is now to be done, is the question. One heavy engine can take all our increased freight at one load, at an annual expense for the maintenance, of but $ 5000; while on the other hand, if we employ two small engines to carry it, we incur an expense for maintenance of motive power, of some $ 9000 per annum. "Here is a pretty piece of business," say the Directors; "why did not our engineer foresee all this: here he has entailed on us an annual loss of $4000, at the very least. Did not experience, all the world over, show that railroads attracted new business to themselves? Did he not know that heavy engines were more economical than light ones? Did he not see that they were introducing them on all the English railroads? However, what is done cannot be helped; we have been behind the age long enough: let us try to catch up with it at last; let us order a thirteen ton engine, or rather, as the business will certainly continue to increase, let us get a twenty ton one, at once." This is accordingly done; and the "fell destroyer," this "monstrum horrendum *ingens*," is trotted out. They build a fire in him;—he snorts;—he starts;—he is off. "Ah! this is something like; now we are up

with the age." But, alas! in a few months things undergo a change. Rumors, faint at first, but gradually gaining strength, reach the Directors' ears, that something is going wrong on the road. An investigating committee is appointed; they visit the road, or rather the spot where once it stood; for the road itself has vanished: it is "*non est.*" After a long and laborious investigation, assisted by several scientific and practical gentlemen, the committee report that, first of all,—the bar was mashed into the timber;—and then—the timber was mashed into the ground. They moreover state their conviction that the flat bar has proved itself utterly unfit for railroad purposes; and suggest that as the Directors of the Liverpool and Manchester railroad have recently found it expedient to adopt an edge rail, weighing seventy-five pounds to the yard, *therefore* a similar rail should be substituted for the miserable flat bar on their road. The heavy rail is accordingly ordered, and laid down. "Now we are certainly up with the English; we have as heavy engines as they have, and as heavy rails; therefore, the road *must* pay well. We can carry sixty tons with our new engines, as easily as we could carry thirty with our old ones, and at very little more expense; that settles the matter. If the road yielded eight per cent. before, it must unquestionably yield 16 per cent. now, with double the business; and the expenses of transportation only the same as originally."

This certainly looks somewhat plausible; but it is found, notwithstanding, that somehow or other the road now don't pay at all. "What! our miserable flat bar road, and tea-kettle engine, pay eight per cent., and our edge rail, and twenty ton engines, a losing concern? How does this happen?" It happens thus: *the road has now cost too much*; eight per cent. on a road costing $ 10,000 per mile, is but four per cent. on one costing $ 20,000 per mile; and in our order to England, we omitted one very essential item to the success of heavy rails and powerful engines, and that is, a heavy trade. Now, had we, when our business increased 100 per cent., merely put on two more small engines, every thing would have worked very well; and the road would in this case have yielded sixteen per cent., instead of eight. It is true, that two heavy engines could, at an expense of maintenance of but $10,000 annually, have done the work of the four light ones, which cost annually, perhaps, $ 18,000; but in order to save this difference of $ 8,000, we must have had a road proportioned to the heavy engines; and to secure this would probably require an expenditure, the interest on which would be many times greater than the $ 8,000 saved on the engines.

The foregoing is, of course, but an imaginary case. Still it serves to illustrate the principle, or rather, *want of principle*, on which far

too many of our railroads are now being constructed, all over the Union. We see whole states falling into the error; indeed, we are falling into it, nationally.

I conceive that this mania for the *indiscriminate* use of heavy engines and rails, has done more injury to the railroad cause, than perhaps any other single consideration that has been brought to bear upon it; but "Dulce est desipere in *Loco*," appears to be the general motto, and it is probably useless to cry out against it. No position can be more tenable, more absolutely palpable, than that it is true economy to use the very heaviest engines, and best constructed road, *that the business requires*. But what constitutes a heavy business in one case, may be a very light one in another, and vice versa. The matter admits, in almost every instance, of calculations sufficiently approximate to determine the class of road, and machinery, that should be adopted; and had this expedient been resorted to on all our railroads, we should probably not have had a single one in the United States, yielding less than ten per cent. on its cost.

I sincerely trust that I shall not be accused of disaffection towards permanent railways, and heavy engines; on the contrary, I repeat emphatically, that they should be as permanent, and as heavy, as the business they are to accommodate can possibly justify. What would we think of a company who should purchase the Great Western steam packet, to ply hourly across the river at Philadelphia, with some five or ten passengers at a trip? Would we not pronounce them demented? And should they tell us that Philadelphia had gone on increasing so rapidly, and so regularly, for many years past, that they felt confident their number of passengers would increase 100 per cent. in ten or fifteen years more, would that diminish our suspicions of their insanity? But yet does it follow, because the Great Western would not be a profitable investment in this case, that therefore she is not a fine sea vessel, and admirably adapted to carry on a lucrative business between England and America? Or does it follow, that because *she* was a losing concern when running between Philadelphia and the opposite shore of the river, that therefore a first rate, substantial little steam ferry *boat* should not do an excellent business on the same route? Or, lastly, suppose that the engines of the two boats, should be respectively converted into locomotives, for accommodating precisely the same limited amount of business *on land*, does that in any degree alter the case? Is it not equally apparent in either instance, that the magnitude of the *trade*, and not of the *boiler*, must be depended on as the great prime mover of the enterprise? I certainly should consider the engineer who would advise the same character of road, and machinery, in every case, fully as deficient in

judgment as the company who should convert the Great Western into a ferry boat.

The remarks applicable to heavy engines, apply also to heavy cars. To diminish the weight of the engines, and still allow that weight to be exceeded by the cars, were evident impolicy. As before remarked, I should on our road, limit the weight on any one wheel, to one ton; and should, consequently, so proportion the cars, as that when loaded they should not exceed that limit.

We often hear the remark, nay, I presume that nine engineers in ten, throughout the profession, will yield it their unqualified assent, that the power of an engine is less on the flat bar, than on the edge rail, by some twenty or twenty-five per cent. In *strict justice,* I suspect there is no foundation for this assertion. I doubt not that an engine *adapted to the flat bar road,* will be found to exert quite as much power on it, as on the edge rail; but, unquestionably, if we place on it engines so heavy as to crush it, and deflect the timbers, a different result must follow. Indeed, it would not be difficult to conceive of an engine so heavy as to deflect the road to such an extent, as almost to deprive her of all locomotive power.

The examples assumed in the foregoing pages, have been taken at hazard, merely for the purpose of illustration; but so far as the character of road, and engines, which I have suggested, are concerned, I am of opinion that they will be found in very numerous instances, preferable to light grades, heavy edge rails, and powerful engines; particularly on the score of original expense. Roads built after this plan, will not partake so much of an experimental character, as those involving greater outlays; and, moreover, they would be adequate, under proper management, to accommodate, with perfect ease, far more trade than passes over half the roads in the Union. For example, there are few of our roads doing a business as great as could be taken at two trips daily, in each direction, by eight ton engines, over sixty feet grades. What folly is it then in such cases, to double the cost of the road for easy grades, heavy rails, and powerful engines? The arguments usually brought to bear against advocates for cheap roads is, that the business will soon increase to such an extent as to pay well on the cost of a first-rate road. This may be true in many instances, but there are more cases to which it is not applicable; for even admitting that the business did, in ten or twenty years, increase 200 or 300 per cent., it by no means follows, that even *that* amount would justify a first class road.

The engineer is not left altogether to the exercise of his discretion, or judgment, in the matter. It admits, as before stated, of an arithmetical determination, having the data of the probable amount of

trade that will be accommodated by the road. In collecting this data, he should shun alike, assumptions based upon the probable business of the road for the first day, or even week, or month, or year, of its going into operation: and thus having in view the prospective resources at the termination of the coming half century.

I will here take occasion to remark, that more, both of time and skill, will be required, to locate a railroad on the principles I have advocated, than on the ordinary plan. When, as is usually the case, the route is located, in great measure, with a view to long stretches of straight lines, easy curves, and light grades, the "modus operandi" is much less complicated, than when the engineer shall be obliged, at almost every step of his progress, to test his cuts, curves, &c., by the standard of justifiable expenditure. It is a very easy matter for the engineer to draw a long straight line on his map, and then tell his assistants to run it out; but it will be somewhat more difficult to decide on that line, between the same points, that shall best subserve the pecuniary interests of the company. In the one case, the route may be located *by miles;* in the other, it must be done *almost by inches.* Perhaps every engineer will bear me out in the assertion, that the difficulties of a proper location must be inversely as the finances of the company, should this system be adopted. As before remarked, the present plan has but little, if any, reference to that point.

I shall not attempt to follow Mr. Ellet into those cases which he supposes, in which it may become advisable to assume grades, more nearly coincident with the natural surface of the ground, and to dispense with the use of iron rails altogether; using cars no heavier than a light barouche. I may, however, be permitted, en passant, to express my entire assent to his views in that particular. Many short branches, from great thoroughfares to watering-places, or to small towns, might be constructed, and made to pay well, could we but divest ourselves of our "stereotyped" notions of what constitutes a good railroad. Witness the railways laid in coal mines: there are none more serviceable;—there are none that pay better;—yet they do not cost $ 20,000, or $ 30,000, a mile; nor do they ever feel the weight of even a *model* locomotive. How powerful an appeal do they make to us, *to proportion the means to the end.*

I will now add some further remarks in support of my views respecting the location of a line of railroad; and again let me express the hope that I shall not be misunderstood as expressing my ideas of the best *abstract* line, but of the best *paying* line;—not that on which a load can be propelled by the least expenditure of *power*, but by the least expenditure of *money;*—not that whose merits are apparent on the ground itself, but which are evidenced forth resplendently, in the

countenances of the stockholders, as they button up their pockets, on dividend day. I am fully aware of the obloquy to which an engineer exposes himself, in lifting up his feeble, and almost solitary voice, against any of the prominent evils of the day; and I am therefore the more desirous to be distinctly understood.

On nearly all our railroads, of any length, there occur at various points, maximum grades, of from thirty to fifty feet to a mile. These grades limit the capacity of the engines; and one such occurring on a road, (unless additional power be employed at that point,) does this quite as effectually as fifty would. Yet on the same road, we almost universally (perhaps *universally*,) see very great expense incurred all along the line, to secure much lighter grades, even where somewhat heavier ones would have coincided with the natural surface, and have involved little or no expense. This practice, *at least to the extent to which it is generally carried*, (for there are many exceptions,) I look upon as radically wrong.

Undulations in the acclivities of a railroad, it is admitted, must be allowed to a certain extent; but the precise limits of the expression, "certain extent," it is needless to say, have not been as yet defined. The application of the term must, of course, vary in each separate road; and perhaps its most literal interpretation, as sanctioned by practice, would be, "Such as the engineer considers the nature of the ground to require." This construction I should be willing to modify, by adding, "and the best interests of the company demand."

Admitting then, *that acclivities must occur* on the line, affecting the load of the engine, I am under the impression that the *number* of them may be increased greatly over what is customary; or, in other words, that the graded surface may be made to conform much more closely to the natural one, than is generally done; and that it would be to the interest of companies, were that system adopted. Under such circumstances, a succession of undulations, within limits not too restrictive of the speed of the engine, it is well known would involve no loss of either time, or power, injurious in practice.

It is true, that Robert Stephenson, Esq., Civil Engineer, in his report to the Directors of the London and Birmingham railroad company, on the subject of undulatory railroads, objects that the variations in speed attendant on alternate ascents and descents, would create an irregularity in the intensity of fire in the engine, which is calculated to injure their boilers by frequent expansion and contraction;—and he states, moreover, that the parts of an engine should be calculated for a certain degree of speed; and that rate maintained as regularly as practicable while on duty, in order to secure the attainment of the most effective performance. He speaks, however,

with regard to the "*undulatory system,*" so called, of Mr. Badnall; and from one of his observations, I suspect that his remarks are not intended to apply to such rates of acclivity as those I refer to; or to such as would permit the engine to start up them, with her load, from a state of rest. For he says, "*Inconvenience would, in my opinion, result from not having the power to halt at any given point on the line of railway. This may be done, without inconvenience, on a line of road not possessing inclinations beyond the power of the engine.*" Such inclinations, my suggestions, of course, do not embrace.

This is, then, the only objection (if indeed it be one) that I have ever seen, that appears to militate against the adoption of a constant succession of short undulations. Should there be others, that have escaped my notice, I have little doubt but that they would be countervailed many fold, by the saving of expense accruing from their adoption, on almost every road in the Union. Indeed, many of our roads might, in my opinion, have been materially improved, by applying the saving that would have been thus effected, to the reduction of their maximum grades. The profile of the road would, it is true, in this last case, present a greater number of undulations; but both the time, and expense, of overcoming them, would be less than in their present condition. The increased facility of drainage, in a railroad of this undulating character, should be taken into consideration, in deciding on its adoption, or rejection. The draining of long level reaches, is, in some cases, a matter of considerable difficulty. I doubt not, most of my professional readers can recal instances in which this inconvenience could have been obviated, and a far better road-bed made at much less expense, by the use of moderate undulations, in which the acclivities need not have been one quarter so steep as the maximum grade. None but a very inexperienced engineer would abuse this system, by so arranging his undulations as to create a continual variation in the speed of the engines, so considerable as to become a source of annoyance to either the passengers, or the engine-man.

But there is, unfortunately, a very powerful antagonistic principle, subject to no laws of either science, common sense, or economy, that is too frequently brought to bear upon the grades, curves, &c., of our railroads; and that is, a puerile pride: a determination to have a *handsome* road, at all events. We know that a succession of ascents, and descents, mars the beauty of a straight line most deplorably; and as the expense of the cosmetic is paid by the stockholders, and they are not aware of its precise amount, it does not matter so much to the engineer, if the road, in consequence of these superfluous embellish-

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ments, should happen never to realize any dividend. In this case, nobody ever thinks of attaching censure to him: the road is very straight, and very level; and, in their opinion, it follows that the engineer has done all that was in his power, to make the project succeed. The amount of trade he, of course, cannot control; and the very fact of his having ruined one road, thus becomes his strongest plea for procuring the management of another. Had he made a road that would pay well, his professional character would probably have suffered an injury, from which it never would have recovered. Until the *public*, therefore, as well as engineers, begin to view this matter in its proper light, we cannot reasonably hope to see the proper remedy applied. A long straight line is considered quite a stepping-stone, by our aspirants after professional fame. It shows for itself; and speaks for itself; silently, but convincingly. A straight line, five or ten miles in length, creates more *talk*, and begets more *honor*, than a judicious curved route could possibly do; although the latter would have answered just as well, and have cost many thousands less. The public must learn, that in a railroad, as in women, beauty is not a safe criterion of merit.

Another frequent source of unnecessary expense in the location of railroads, is the attendance of a "Committee of Survey," appointed from among the Directors, *to assist the engineer in making his location!* The primary object of this committee, we are in charity bound to suppose, is to prevent, by their intuitive skill, too much use of the level and compass; at least, this is certainly all they ever *do* effect. These gentlemen are generally as innocent of all knowledge of the principles of a location, as "the child unborn;" and, by their twaddle, they soon torment the very life out of the engineer. Their questions, and remarks, must be listened to; and to do this is utterly incompatible with any attention to the location. This demands, at every step, the undivided observations of even the most skilful engineer; and admits of no diversion from the main object. Therefore, after a few miles are located, the engineer, completely exhausted by his double duty, invokes all sorts of maledictions upon the committee, and determines upon the long-straight-line system, as the only relief from his misery. He starts his corps off at a tangent, through thick and thin, for some object several miles distant; and *then he is at leisure to talk.* He is commended for his long straight lines; the committee for their vigilance; and the stockholders pay the costs.

Let Directors, if they *must* appoint "Committees of Survey," give them instructions to *remain at home, and let the engineer alone;* and further, if he reports that he has finished his examinations, and surveys, in an unprecedentedly short time, discharge him, and procure

another to make a thorough and correct survey. They will generally save at least one-third of the costs of their grading by this process. *It must be a long purse, that pays for a short survey.* Although I have treated this last subject in a somewhat sportive manner, it is nevertheless one worthy of the most serious consideration. Let Directors employ an engineer, in whom they can place *unlimited* confidence for professional skill and integrity; then give him his general instructions, if they have any to give; and afterwards leave him entirely to himself in his operations. And especially let them, in their mercy, refrain from urging upon him their sons, nephews, and other "very talented young gentlemen," as assistants. Let him choose his own assistants; and let the Board abstain, most religiously, from any interference with them. They are the engineer's tools, by which he carries his plans into execution. No one else should meddle with them; to do so, will inevitably blunt their edge, and give to both the workman, and his employers, trouble and expense. Harmony among the officers, is all essential to the proper prosecution of any project; and the remark applies with peculiar force to works of internal improvement. The engineer, if he be the kind of man above supposed, will feel himself identified with the work under his charge. His interest, his pride, his professional character, are all concerned in its success. No stockholder, no director, can possibly feel that intensity of interest in it, that he does. Every effort he can make, will be brought to bear upon its successful accomplishment; but let once the Directors begin to meddle with his operations: let them pass along the line, and give directions to his assistants, or contractors: let them evince any want of confidence in his integrity, and the charm is dissolved. His interest is changed to disgust. His professional pride no longer sustains him, and inattention must *inevitably* follow; and just so certainly as that happens, the work must suffer.

If Directors could consent to leave the principal management of the matter to the engineer, there can be no doubt, that in almost every instance, he could either prevent claims for land damages entirely, or else reduce them to a very unimportant item. But to effect this, it is *essential* that he should act either alone, or through a discreet agent, who must be entirely in his confidence, and *under his control.* A sum sufficient to defray the engineering expenses of the entire work, could thus be saved, in nearly every case; but it can be done only through the engineer; and not even through him, unless he be permitted to keep his own secrets, until the whole matter is arranged.

It is not my intention to treat on the management, or conducting, of a railroad, after its completion. I will merely observe, that it is a great error to entrust it, as is almost universally done, to men of very

limited information. The general agent of transportation, under whose direction the operations of the road are conducted, should be an engineer, of considerable attainments; although it is not necessary that he should be one of the first grade. The professional ignorance of most of the conducting agents of our roads, is a lamentable source of waste. Many of our unproductive works could be made profitable, by a change in that department alone.

In conclusion, let me again earnestly request that no mis-construction be put upon the foregoing pages. There are many railroads in the United States, to which my remarks are not at all applicable; but there are also many to which they are. Where there is a very heavy trade to be accommodated, I am in favour of easy grades, curves of large radii, heavy rails, and powerful engines. But in all cases, these traits should be combined only so far as *the interests of the companies will justify*. I maintain that our engineers should construct their roads, with a view to *paying* well, instead of *looking* well; and that in looking to England for precedents, they should rather apply the *principles* there developed, to our own case, than attempt to indulge in an imitation of their splendid *practice*, when so doing must necessarily bring ruin upon those who embark their all in the enterprise. Nothing can be more evident, than that we have, in numerous instances, transcended the limits between *abstract* and *practical* perfection in our railroads. The former, as before remarked, is that in which the greatest load can be propelled by the least *power*; the latter, in which it can be done at the least *expense*. The expression, "a good railroad," is a *comparative* one; we have erred all along, in supposing it to be *positive*. It is to correct this evil, at least partially, that I have been induced, on the perusal of Mr. Ellet's pamphlet, to add my exertions to his, by the publication of these pages. Being written on the spur of the moment, and in the order they presented themselves, on reading his pamphlet, my remarks are, of course, crude and incomplete. The subject admits of much enlargement, and I hope to see it followed up in future numbers of the Journal, by more vigorous pens than mine. In the meantime, I cannot do better than to recommend to those who wish to see it more ably handled than they have found it in this paper, to study carefully Mr. Ellet's judicious remarks, in the pamphlet alluded to.

Tennessee, February, 1842.

Projected Water Works at Albany, New York.

We have been favored by W. McClelland Cushman, Esq., Civil Engineer, with a copy of a recent report made by him to the authori-

ties of Albany, on the means of watering that place from the Mohawk or Hudson River.

It appears to be settled, by long experience, (with few exceptions,) that very populous towns, cannot easily be supplied with salubrious water from springs, or wells upon their sites; because the contaminating causes incident to a dense population, sooner or later, impregnate the existing waters of the place with impurities, both offensive and deleterious.

Consequently a necessity arises, at some period of the growth of almost every town, which demands the procuration of water, for beverage and culinary uses, from distant and uncontaminated fountains.

This necessity has created an independent branch of engineering, scarcely yet reduced to the character of a precise art, the importance and utility of a clear knowledge of which—especially in a country fast increasing in population—must be manifest to all.

It has often been to us a source of regret that no authoritative work, or text book, exists, which contains at once both the principles and the details, indispensably requisite for the correct guidance of works of this character; such a production is at present a desideratum in civil engineering, and one which we do not despair of seeing supplied, by some of the able men now engaged in the important business of watering our cities.

To return to the immediate subject in hand, we conceive that Mr. Cushman by adhering too closely to the theory of this question, (of which he is undoubtedly master,) has fallen into some practical errors, which the importance of the subject as a matter of engineering, induces us to point out.

In this task we have been materially aided by consultation with practical men, entirely conversant with the experience developed in the use of those celebrated works by which this city and its suburbs are so successfully watered, *through cast iron conduits extending more than* 110 *lineal miles, and daily delivering to the people nearly four and a half millions of gallons of water.*

The following points in Mr. Cushman's report appearing to us to be discordant with practical results and views, we shall offer a few remarks upon each.

I. After establishing the height of the fountain, necessary to cause the water in the conduit to flow to the roofs of the highest houses in Albany, he proposes "for the extinguishment of fires, *an additional head of ten feet*, as great enough to force upon the roofs (from the streets we suppose,) a jet d' eau, by means of a short hose applied to the hydrant, and *without* the intervention of ladders, &c."

Upon this we may remark, that although the reservoirs at Fairmount possess an average command over the pavements of the greater part of Philadelphia, quite equal to that proposed at Albany, (55 feet,) still it is not found possible in practice here, to throw water upon the roofs of burning buildings, by the mere force of hydrostatic pressure; but almost invariably, it is from necessity first poured into engines, by the hose, and thence projected by manual labor.

In view of these facts, we can come to no other conclusion than that *the additional head of ten feet* above the levels of the roofs, will be found wholly insufficient to project from the streets a jet d'eau upon those roofs.

To strengthen this view we will observe that there is now in action at Fairmount, a jet d'eau, established under very favorable circumstances, for producing a high projection of water—the pipes of supply are of the most ample dimensions—the adjutage comparatively of small size, and duly proportioned according to art—yet it rises in the air but little over thirty feet, though actuated by the full head of the reservoir, nearly eighty feet perpendicular above the adjutage; theoretically this jet *ought to rise* much nearer to the level of its head, but the stubborn fact is that *it will not.**

II. Mr. Cushman proposes to cause his conduits to follow the average contour of the ground, graded for the purpose in planes as long as possible.

To this there can be no objection, provided sufficient strength is given to the pipes, a suitable increment of head added for every undulation of the conduit, and a proper air valve placed upon the summit of every vertical convolution.

III. Mr. Cushman proposes the construction of *"depurating sections"* and *"roil chambers,"* in the lowest undulations of the conduit, with sluices to clear these undulations from sediment.

Now as *settling reservoirs* are also proposed in this report, it seems to us that though a simple cock placed at the lowest depressions, might occasionally be serviceable, the *sediment apparatus,* as planned and described, is both unnecessary and objectionable—*unnecessary,* because experience in this place, where undulations of the con-

* It may be useful to be more explicit in describing this jet d'eau; the pipe of supply consists first of an old sixteen inch main—devoted to this purpose only—which descends from the reservoir, on the summit of Fairmount, to a plane about eighty feet below it; here a branch pipe, of four inches calibre, is taken off horizontally about one hundred feet to the fountain, where it joins *a short vertical pipe* of one inch in diameter, which at the adjutage is contracted gradually to five-eighths of an inch, by means of cones, according to the principles of Venturi; and, though an orifice in a thin plate set in the four inch pipe, would have been more effective, still this is a case favorable to the production of a high jet—yet such a jet as might have been expected *does not result.*

duits are frequent, indicates that if the pipes are laid in sections of *uniform aperture*, duly proportioned to the service they perform, and possessing a suitably commanding head, it is only requisite to open the fire plugs occasionally to produce an effectual scour through the pipes, and bring forth any sediment which may have lodged within them;—*objectionable*, because the *roil chambers* being *enlargements* of the conduit, *preceding a contraction*, will obstruct the flow of the water, and have a direct tendency to produce the very evil they are designed to cure, whilst at the same time they would occasion an additional expense, which might be much more advantageously applied to augmenting the altitude of the working head of water.

IV. Mr. Cushman calculates that a thickness of one-twentieth of an inch of cast iron would be "*amply sufficient*" for an eighteen inch conduit pipe, working under fifty-five feet head! But for perfect safety he finally establishes the thickness at fivefold, or *one-quarter of an inch*, and thence estimates the weight of metal per mile of conduit, at 103⅓ tons.

Now the cast iron conduits of this city, of eighteen inches calibre, working many of them under a head not exceeding that mentioned above, have had their proportions established by over twenty years' practice, and are now made *two-thirds of an inch* thick in the body, and weigh 410 lbs. to the yard lineal, or 322 tons per mile of pipe, *being more than treble that prescribed by Mr. Cushman!*

We may, possibly, be told that two-thirds of an inch is a much greater thickness than would be dictated by formulæ based upon the known value of the cohesive force of cast iron—and this we readily admit; but at the same time, *here is the practical fact*, that the conduits in the general plane of Philadelphia—working under nearly the same head as that proposed at Albany—require to be made two-thirds of an inch thick, and tested, too, by Bramah's press, under an hydrostatic pressure equivalent to 300 feet head, before being laid down; yet notwithstanding all this, they do sometimes fail, *though very rarely*, and though it may be said with truth that these failures usually occur at imperfections, still it shows the large margin necessary in practice, to guard against those very imperfections, which are unavoidable in castings, and which the hydraulic press does not always point out.

If, then, the conduit pipes for the water service of Albany, be proportioned by the practical scale established by more than twenty years' actual experience here—the propriety of which but few will question—the cost of this item alone will thrice excel that expressed in Mr. Cushman's estimates, (p. 21 of the report,) or be more than $300,000, instead of less than $100,000!

V. Mr. Cushman proposes that the pipes should be cast in lengths of fifteen feet.

And on this we shall only remark that those of nine feet long have hitherto been found sufficiently difficult *to cast well*, and the opinion of practical men in this quarter is decided, that *good pipes* cannot be cast in lengths of fifteen feet, without increasing the weight per lineal yard, to guard against unavoidable imperfections.

VI. Mr. Cushman proposes *to use zinc instead of lead* to seal the joints of the conduit pipes, under the impression that by galvanic action it will prevent the iron from corroding.

Of this plan it may be observed, that wherever one metal in a galvanic circuit is protected by *another*, it must be at the expense of *that other;* if, then, the zinc joint protected the iron pipe, it would be *itself* corroded, and from this cause the joints would soon become imperfect, and need repair.

Moreover (to take no account of its extra cost,) zinc is too friable to admit of being set up with the cold chisel, after being cast into the joint—which is an indispensable precaution—and it may well be doubted, whether its very slight ductility would successfully admit, the expansion and contraction which takes place in metallic conduits, and to which the common joint of lead so admirably adapts itself, as to leave absolutely nothing to be desired, in point of tightness and durability; indeed, some which have recently been examined *after thirty-three years' use, were found to be in perfect order.*

VII. Mr. Cushman proposes so to gear his forcing pump that the water in the rising main, when the pump is working, shall have a velocity of *only sixty-five feet per minute*, or "thirty single strokes" of a twenty-six inch barrel.

Now experiments at Fairmount have conclusively shown, that when the working velocity of the water in the main, ascending from the forcing pump to the reservoir, *is less than* 120 *feet per minute*, the momentum is not kept up, whilst the piston clears its dead points; and consequently a reaction then takes place upon the principle of Mongolfier's ram, which would quickly destroy the most solid apparatus; it is on this account, as well as with the view of avoiding gearing, that the water wheels at Fairmount are run so much faster than theory dictates—or than otherwise would be desirable—and not from any want of knowledge of the best abstract velocity at the skirt, as some uninstructed critics have imagined.

The length of the force pump stroke, as proposed by Mr. Cushman, is twenty-six inches, which, we are inclined to believe, *is too short for advantageous action.*

There are some other points in the report under review which seem

open to objection, but as they are comparatively of minor importance, we will conclude our remarks without entering upon their discussion; indeed nothing but the importance of this practical question could have induced us to review Mr. Cushman's report at all, as we entertain the highest respect for his talents, and feel convinced that with a closer attention to practical results, he would unavoidably have been led to conclusions identical with those above enunciated.

Facts and Observations on Four and Six Wheel Engines. By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 320.]

Birmingham and Gloucester Railway.

Having heard a good deal of the American, or Bogie, engines, I was desirous of riding on them, and Captain C. R. Moorsom, the Chairman, and Mr. Sturge, one of the Directors of the line, having politely granted me permission, I went on the 16th ult. from Birmingham to Cheltenham, 46 miles, on one of Norris' engines, and returned on a copy of the principle built in England.

The readers of the *Railway Magazine* are aware that one of the distinguishing features of these engines is the cylinders being outside, near the head of the engine, with a very long connecting link, or rod, turning by a pin the hind wheels, four feet diameter. Another is the bogie front, that is, four two feet six inch wheels, the two axles of which are very close together, attached to a frame, which has considerable motion round a vertical pin. By this means the engines traverse a curve of only ten chains radius near the Birmingham station with great facility, and without, as far as I could perceive, any undue strain.

I went from Birmingham to Cheltenham on one engine, an American, of Norris' make, and came back on an English model of it.

The first, No. 7, the *Atlantic,* I was informed by Mr. Bishop, the intelligent superintendent of locomotives, who went with me as far as Broomsgrove, weighs in its working trim near ten tons, with about six on the driving wheels. Its cylinders were ten and a half inches, with an eighteen inch stroke. At first I was very much pleased with this engine, and fancied it was the steadiest I had yet traveled on. Its lowness and easy motion at moderate speeds won very much upon me, and impressed me with great confidence. When, however, we came to a speed of above twenty miles an hour, or up to twenty-five or thirty miles, the motion on the platform was a most disagreeable wriggling side motion, which kept time, as far as I could judge, with the beats of the pistons. It was the same on both engines at the same speed. I tried in vain to discover the cause of it. No such motion, or anything approaching to it, had I observed in any engines on which I had been. Mr. Bishop and myself thought, while traveling on the engine, it might be owing partly to the road, and partly to the play of the axles in the bearings; but as it corresponded in both engines, I

was subsequently inclined to think it owed nothing to the road, and was due entirely to the vibrations occasioned by the sudden checks of the matter in the piston, and its material, and the working of the engine against itself, that is, its working too quick for the steam behind the piston to have time to escape. It is probable, therefore, that was the expansive action of the engines—for I am informed they work in part expansively—adapted to the highest velocity required, and the steam behind the piston allowed to escape earlier, none of this unpleasant motion would exist. But these engines are put to motions they were obviously never intended for. Thirty and more miles an hour, which they often travel, they plainly tell us by their laborious motions they are unequal to.

As a part proof of this, I am informed that four engines which the Company have had made, with outside cylinders and five feet driving wheels, by Forrester, to take the mail trains, have no such motions as are found in the American engine and its English imitation.

From what I have seen, I am no great admirer of American engines for general purposes, though the men relate marvellous things of them upon that line.

Besides the wriggling motion mentioned, I could very plainly distinguish the same sinuous motion I had observed on the South Western and London and Birmingham lines.

Captain W. S. Moorsom, the engineer of the line, seems to have a very good opinion of the principles of these engines. I am sorry to differ from a gentleman for whose talents I have a very great respect, but if I am to form my judgment from the two whose performances I have witnessed, they will not have an advocate in me. I could compare their uneasy wriggling motions at high velocities, to nothing but that shuffling amble which is observable in some small ponies, and I cannot help thinking but that they must have considerable wear and tear, and be expensive to keep up: and this, I since find, is fully borne out by the facts. Some of the men, however, are enthusiastic in their favor, and ridicule the idea of "Bury's engines" being able to compete with them on their line. They say the trial has been made, and the superiority of the American engines placed beyond a doubt. The rationale of this I am unable to see, but if it be so, it settles the question, and proves that little engines, like little horses, are best suited for hilly countries; but why then, as it will presently be seen, are the Company improving them, by substituting five feet, for four feet driving wheels?

The length of line worked by this Company is fifty-five miles, including the Tewkesbury branch of two miles; and when the Worcester branch is opened, four miles, and the line extended one mile further, to join the Gloucester basin, which I understand is now in progress, the total distance worked will be sixty miles; the cost of construction of which will be between £24,000 and £25,000 a mile.

The locomotive stock of this Company consists of twenty-nine engines, including three ballast engines and three "bank engines," to help up the Lickey incline, which last three never work trains. All the traffic engines are six wheel, with bogie frames, to the centre of

which the smoke-box is attached by a centre pin, the engine framing on both sides of the smoke-box resting on stands acting on the bogie frame springs. The cylinders are all outside, and the framings, except of four, all inside. There being no crank axles, the driving-wheels are set back close to the fire-box. The weight of the engines varies from ten to thirteen tons, in their working trim, of which from six to eight lie on the driving-wheels. Most of their engines have driving-wheels only four feet diameter, and the four other wheels being two and a half feet, but they have an engine with five feet driving-wheels, and four others with five and a half feet, the leading wheels of which are from two and three-fourths to three and a half feet diameter. Improvements are now making in these engines, by putting on five feet driving wheels, "and giving as much head as possible to the reduction," or exhaustion, of the steam.

Eighteen of the traffic engines, including the three bank engines, are now in an efficient state. The detentions have been rather numerous, in consequence of the pumps, and other parts of the engines, with the small driving-wheels, having occasionally failed; but it does not appear that they ever had a driving axle fail, except a crank axle in an old ballast engine, eleven years old, which happened at some temporary points; nor have they ever had any engine run off the line. The average cost of the engines is £1,430.

Their gross loads are about fifty-one tons; their consumption of coke, thirty pounds to the mile in Forrester and Nasmyth's engines, and forty pounds in the others.

With regard to their own engines, they find the five and a half feet driving wheels work the best. The chief motions are the sinuous and horizontal vibrations, or tremors, which are most conspicuous in the *Bogie* engines on descending gradients, but on curves there is little or no difference. These motions are considered to be in part, but not wholly, due to the road. They have no top-heavy engines, nor any direct proof that the distance of the cylinders from the principal axis of the engine, has any effect on the sinuous motion; but Mr. Bishop is of opinion that the outside cylinders have.

The average expense of repairs of their engines, for the half-year ending the 30th of June, was £103 per engine, including several new copper fire boxes and tubes, the total distance run in the same time being 110,000 miles. The steam pressure is 60 lbs. per square inch.

Their best engines are Forrester's, three years old, and the worst the *American*, two years old. In their fastest and least expensive engines, the moment the steam is cut off from the induction pipe, the eduction is opened.

Mr. Bishop has addressed a letter to me since I have been out, in reference to the premiums for economizing the coke, in which he says: "for the last three months' consumption, I find forty-four pounds of coke per mile as the general standard, and for every pound which the fortnightly returns show it to be under, the men have £2 to divide among them. Thus, the first fortnight the average was thirty-eight pounds, and therefore the men had £12; the second fortnight the average was thirty-nine pounds, and the men had £10. Each driver's

share for the month was 14s. 8d., the firemen, cokemen, &c., receiving less, in proportion to their wages."

London and Birmingham Railway.

The locomotive stock of this great Company consists of ninety engines, that is forty-two with twelve inch cylinders and eighteen with thirteen, all uncoupled engines; and thirty coupled engines, with thirteen inch cylinders for goods. All these engines are four wheel, and have inside bearings. The weight of the 12-inch cylinder engines, in their working trim, is 9¾ tons, having 5 tons 18 cwt. on the driving wheels, and 3 tons 17 cwt. on the front wheels; the 13 inch uncoupled weigh 11½ tons, with 6 tons 11 cwt. on the driving-wheels, and 4 tons 19 cwt. on the front; and the 13-inch coupled weigh 11 tons 13 cwt., of which the same weight, 6 tons 11 cwt., lies on the driving-wheels, and 5 tons 2 cwt. on the leading wheels. The coupled engines are said to work most satisfactorily, but I presume this is meant for goods, as whenever they are worked with the passenger trains, that is at high speeds, I observed the coupling rods are taken off.

Of these 90 engines, 81 are now in an efficient state, and ready to take a train.

During the last two years there have been ten cases of fractured crank axles. In no instance, however, did the engine fail to take its load to the next station. Seven of these cases have been with goods on coupled engines, and only three with passenger or uncoupled engines. The cause is alleged to have been that singular fact mentioned in my account of the Grand Junction engines, namely, the deterioration of the quality of the iron of the axles from use, which converts hot short into cold short iron.

From these fractures no personal injury was done to any one.

It appears that there has been but one solitary instance (Nov. 4th, 1837) of any engine having run off the rails, which happened between Harrow and the Brent, and was caused by the unsound state of a part of the road then newly opened. It happened with one of the 12-inch cylinder uncoupled engines.

The average pressure of steam is about 50 lbs.; consumption of coke, 40 lbs. per mile; and the gross loads taken are given to me as 61 tons, but I suspect this is the average passenger loads, for we often see trains of goods of an almost interminable length.

It is a fact worthy of notice that their heavier trains are the up, that is, those towards our bottomless gulph—the metropolis—a circumstance which was not contemplated or foreseen before the line was opened.

The cost of their engines is from £1,300 to £1,350, exclusive of tender; the annual expense of repairs, per mile run, about 3½d., and the number of miles run, from June 15, 1840, to June 15, 1841, was 1,066,014. They have no top-heavy engines, and the motions chiefly observed are the sinuous. If an engine has any other motion, it is always found where the road is imperfect.

Their oldest engine, No. 1, I understand has been at work from July, 1837, and is still perfectly effective and steady.

Some very cogent reasons are given me for the preference by this Company of four wheel engines to six; but as they are somewhat long, I have thought it better to reserve them for my report.

More detailed accounts are, that for 6 months ending the 15th of June last, there were employed 16 foremen, clerks, and store keepers; 51 engine drivers, 8 stationary enginemen, 50 firemen, 168 cleaners, cokemen, and laborers on running engines; 93 fitters, erectors, and millwrights; 16 turners, 6 men working on machines, 11 carpenters and pattern makers, 5 coppersmiths, 9 brassfounders, 23 blacksmiths, 3 spring-makers, 36 stokers, 22 boiler-makers, 4 painters, 6 general laborers, and 12 boys; making a total of 539 men and boys. And this number, it will be observed, is employed solely in the locomotive department and in repairs, without any being employed in the manufacture of new engines. Their places of occupation are at four stations.

The 6 months wages for enginemen, firemen, cleaners, cokemen, and laborers on traffic, amount to £7,444 18s.; the coke consumed was 10,012 tons, costing £16,139 6s. 8d.; the oil, 4987 gallons, at an expense of £827 2s. 6d.; the cost of water and firewood, £859 6s. 10d.; the wages or repairs, repairs not done by the Company, and stores or repairs, were £9,448 8s. 5d.; and general charges for tools, stationary power, clerks, foremen, store keepers, and other incidental expenses, were £6,389 10s. 7d., making a grand total of £41,108 13s.

The miles run, including assistant and pilot engines, with passenger trains, were 416,995, and with goods, 126,923. The average weight of passenger trains, exclusive of engine and tender, is 40 tons, and of goods with the same exclusion, 86 tons: and coke consumed per mile for all the trains, including getting up the steam, waste in stoppages, rests, &c., 41 lbs.; the average cost of repairs per mile run, was 4.17d., and of coke, 7d.; and the total cost per mile, including everything, 17.68d.

Six hundred bridges, or between 5 and 6 to a mile, I have been informed, are upon this line, many of them of course perfectly useless, and wantonly extorted from the Company in the progress of the Bill through Parliament. By the vultures in the House, and the cormorants out, near half a million of money was plundered from this Company, for land only, over and above its reasonable value. Had the Parliament exercised a little common sense, instead of the uncommon folly which dictated the 10 per cent. clause, it might, in suppressing the robberies for land and compensation only, have saved this Company more than sufficient to enable it to carry the mail-bags for nothing.

This great line, as the readers of the *Railway Magazine* know, unites the metropolis of the British empire with Birmingham, and forms the main railway artery to the north and north-west of England. Though it passes over a difficult country, its gradients are pretty good, that is, none I believe exceeding 16 feet a mile, except 1½ mile at the London end, worked by a stationary engine.

Much of the material on the line is good, but there are other parts

containing that untiring nuisance to railway engineers, called clay. Here is a constant source of expense; which, however, the large and ample revenue of the Company feels but slightly in comparison to what other Companies would. By constant vigilance these parts are kept in good repair; and, from what I have observed on other railways, though it has not escaped the influence of the late rains, it has felt them less than most, and far less than some.

It has often been asserted to me, that this line is incapable of managing the immense traffic which flows in upon it, and that another line will be necessary to the north. While I have been out I have endeavored to pay some attention to this, for the purpose of obtaining correct ideas thereon. I have, as far as my opportunities would allow me, watched their operations. examined their force, and considered their system, and I am of opinion that their force is so ample, and management so systematic and apparently so easy, that I am of opinion double the present traffic would not much inconvenience them, even as they now are, while I think there can be no doubt that the line might easily take three or four times the quantity it now does.

Monday, Nov. 22nd.—I again traveled upon two of the Company's engines, namely, No. 44. a two year old mail engine, and No. 9, both built by Bury. The first engine I found not near so steady as the second, which was also much more lively, and tripped off with her load in gallant style. I was informed the first consumed 12 cwt. of coke in 52½ miles, and the second 14 or 15 cwt. in 60.

On Thursday, December 9, I came once more upon the line, in my return from the north, and I rode on No. 5 and No. 79. The latter was a coupled engine, with the coupling rods off. Having now been accustomed for two or three weeks to six wheel engines, and somehow had the sympathy of my prejudices excited in their favour, from the constant vibration in my ears of other parties' opinions in their favor, I entered the line with probably more unfavorable than impartial notions of four wheel engines. I imagined my former experience of them to be erroneous, and that I was now about to see the opinion of those I had mixed with, of their roughness, pitching, rolling, and dancing about, confirmed. I was, however, most agreeably surprised to find, not only my previous sentiments of them strengthened, but that they certainly were, to my mind, superior to the majority of six wheel engines in which I had ridden. As it was probably the last time I should be on this line in this survey, I tried these two in every way I could, and I found them comparatively free from the distinguishing motions of other engines, and most decidedly vastly more free from them than nine out of ten six wheel engines I had tried. No. 5 was a very steady engine, but No. 79 appeared to me to be steadier, and sweeter in her motions.

In examining these engines, I found them very firmly put together. The wheels of No. 79, contrary to other engines I had been on, appeared to have no sensible play whatever in the axles; they were so perfectly vertical to the axle-trees, that they ran with the greatest truth. I cannot say that either of these engines was wholly free from

longitudinal, or lateral, motion; but at velocities of about 30 miles an hour, it existed in them in a very small degree.

In now taking my leave of the London and Birmingham Company, I only discharge my duty to my conscience in acknowledging that their whole conduct to me, throughout this affair, has been one unvaried course of kindness and attention. Everything I have asked has been promptly granted me; every assistance I have needed has been given in a way to double the pleasure of receiving it. So far from holding back, they have seemed to take a pleasure in anticipating my wants or my wishes; and that generous conduct which began with Mr. Glyn and Mr Creed, has been handsomely followed out by his assistant, Mr. Long, and Mr. Robinson, Mr. Jones, and every other officer and servant of the Company, with whom I have come in contact, or had intercourse. Railway Mag. Dec. 1842.

[TO BE CONTINUED.]

Advice to Stockholders in Railroad Companies, from Herapath's Railway Magazine, but suited as well to the Western, as to the Eastern Hemisphere.

The period has now arrived, when in most cases the lines are completed, and questions of construction have to give way to those of administration. The lines are made, the great point now is to make the most of them by extending the traffic, and by regulating the expenditure. Let every Shareholder keep a watchful eye as to what is going on, for his conduct at the present meeting will much determine his dividend at the next. Let him see that the traffic is carried to its full extent by moderate and profitable fares, and what means exist of bringing other lines into communication, or assisting in the formation of new ones. He must have satisfactory explanations that the expenditure is not upon sinecure or extravagant offices, at the same time that he must take care that the officers and servants of the company are properly paid. A few well-paid officers are worth a legion of under-paid and discontented pensioners, and false economy with this class may, as in recent cases, be not without its effect upon the income. We cannot refer to the recent defalcations, and to the discontent prevailing among railway employees, without alluding to the fact of the dividend of the Manchester and Birmingham Railway Company having this half year suffered a diminution in consequence of misconduct on the part of one of the establishment. A lesson this, which will not, we trust, be lost upon those who are inclined to penny wisdom and pound foolishness. A cheap, that is, an unqualified servant, will always waste more than is saved on his salary, doing less work, and requiring more superintendence.

To secure good management, it is not enough to ask for it or to talk about it, but to choose the men best qualified. Where you have no auditors, ask for them, and insist upon having them, and chosen by yourselves—where you have to fill up vacancies in the direction, take care to put in proper men. Many a line at the present moment

requires a sharp eye; there are other things than the petty fees to attract the corrupt or the greedy; in the expenditure of thousands and hundreds of thousands, there is much more to be got by a practised hand, than from all the fees that a most diligent attendant can finger. The fees, we are convinced, attract but very few, and those, perhaps, the best men, the real working men; vanity and the love of pre-eminence and power may incite some; but the main incitement towards the direction, in low minds, is the love of a job. These are men to be closely looked to, men who will use every exertion to intrigue themselves into office, and then remunerate themselves at the expense of their constituents. One of these men is in league with a coal-merchant, another with a coachmaker, a third supplies timber sleepers, and a fourth, rails. Even to the clothing of the policemen, the oil and grease for the engines, and the stationary for the office, nothing is beneath the notice of these worthies; every one has a share of the spoil, and so generally are some boards affected with these practices, that the contracts of the line are as sytematically quartered out as the patronage of a cabinet, and each receives a share according to his merits. Mr. Alderman Jobbins has a son who is a tailor, and he takes the clothing; Mr. Deputy Grub lays his hands on the supply of coals and coke: the Chairman walks off with an order for rails; and his deputy undertakes to get the carriages repaired. These are very useful things to keep up influence in a man's parish, or ward, while the several parties who reap the fruits of the system are bound to use their power in keeping the Directors in place. Neither are such Directors always contented with their fees, or their patronage, but frequently they must have vestry dinners at the Company's expense, and turn the board room into a free and easy, where pots of porter and mutton chops are brought to aid the deliberative powers of the midday councillors, and restore their energies, exhausted not in the Company's service. All these things are to be looked at, and the parties engaged in them, when found out, to be removed from office; but Shareholders will do but half their work if they are not at the same time cautious by whom they are replaced. There can be little difficulty now in finding a sufficient number of tried public men, who are willing to accept office, and there is quite enough legitimate patronage and power to render any plea for jobbing quite inexcusable.

Physical Science.

History of the Reflecting Telescope. By the Rev. T. R. Robinson, D. D., M. R. I. A.

After explaining the relative importance of magnifying and illuminating power, Dr. Robinson proceeded to give a brief sketch of the history of the reflecting telescope, which seemed to have been forgotten for many years after its invention, till it was revived by Hadley. The labours of Short soon gave it celebrity; yet even this artist limit-

ed himself in almost every instance to sizes which were not more powerful than the achromatics of his day, and his large instruments appear to have been failures.* It was not till a full century after the publication of Newton's paper, that Sir William Herschel gave this telescope the gigantic development which has crowned him with imperishable fame; and by the construction of telescopes of nineteen and forty-eight inches aperture, placed regions almost beyond the scope of measurement, within the reach of human intellect. But as Short, in a spirit unworthy of his talents, took care that his knowledge should die with himself, and Herschel published nothing of the means to which his success was owing, the construction of a large reflector is still as much as ever a perilous adventure, in which each individual must grope his way. Accordingly, the London opticians themselves do not like to attempt a mirror even of nine inches diameter, and demand a price for it which shows the uncertainty and difficulty of its execution. In Ireland we are more fortunate, for a member of our Academy, Mr. Grubb, finds no difficulty in making them of admirable quality up to this size, or even fifteen inches; but with all his distinguished mechanical talent, he is believed to be doubtful of the possibility of more than doubling this last magnitude in perfect speculum metal.

Under these circumstances, too much praise cannot be given to Lord Oxmantown, who, in the midst of other pursuits, has found leisure for such researches; and by a rare combination of optical science, chemical knowledge, and practical mechanics, has given us the power of overcoming the difficulties which arrested our predecessors, and of carrying to an extent which even Herschel himself did not venture to contemplate, the illuminating power of this telescope, along with a sharpness of definition scarcely inferior to that of the achromatic.

The chief difficulties which are to be overcome in the construction of reflectors, arise from the excessive brittleness of the composition of which specula are made, and from the necessity of giving them figures which shall be free from aberration. The great mirror in the Newtonian form is (if the eyepiece and plane mirror be correct) the conical paraboloid.

It is necessary that speculum metal should possess, in the highest attainable degree, the qualities of whiteness, brilliancy, and resistance to tarnish. Lord Oxmantown has found that these conditions are best satisfied in the *definite* combinations of four equivalents of copper to one of tin; or by weight, 32 and 14.7 nearly. Metals differing from this by a slight excess of either component, are, when first polished, scarcely less brilliant, but are dimmed so rapidly that the lapse of a few days produces a sensible difference. On the other hand, some large specula of the atomic compound have been lying uncovered for years, without material injury to their polish.

But this compound is brittle almost beyond belief; a slight blow,

* A Newtonian of six feet focus, and 9.4 inches aperture, is said by Maskelyne to have shown the first satellite of Jupiter 13″ longer than a *triple* achromatic of 3.6 inches aperture. The telescope of twelve feet focus, and eighteen inches aperture, now at Oxford, showed multiple rings of Saturn.

or even the application of partial warmth, will shiver a large mass of it; though harder than steel, its surface is broken up with the utmost facility, and it has a most energetic tendency to crystalize. The common process of the founder fails with it, except for masses of very limited magnitude, as the cast cracks in the mould; and the subsequent difficulties of the annealing are such, that it has been a very general practice to use an alloy lower (containing more copper) than the atomic standard. Even Sir William Herschel was obliged to yield to this necessity. It appears from a letter of Smeaton, (Rees's Encyclopædia, Art. Telescope,) that for his 20-foot mirror of 19 inches aperture, the composition was 32 copper to 12.4 tin, and that for the 40-foot it was even lower; yet two out of three attempts to cast this huge speculum failed.

Lord Oxmantown at first endeavoured to evade the difficulty, by constructing a speculum in pieces, soldering plates of fine metal to a back of a peculiar brass, ascertained to have the same expansion; and has completed one of thirty-six inches aperture, and twenty-seven feet focal length, which performs very well on stars below the fifth magnitude, but above that exhibits a cross formed by the diffraction at the joints; and in unsteady states of the air exhibits the sixteen divisions of the great mirror on the star's disk. By diminishing the number and size of the joints it is found that these inconveniences can be diminished, so as to be scarcely perceptible; and in all probability this is the process by which the remotest limits of telescopic vision will ultimately be attained. It is, however, not necessary for instruments of even greater dimensions than this, since Lord Oxmantown has succeeded, by a contrivance as simple as ingenious, in casting, at the first attempt, a *solid* mirror of the same size; and there is no reason to suppose that it will be less effective on a much larger scale.

But however difficult it may be to obtain the rough speculum of large dimensions, it is still more so to give it a proper figure, combined with that brilliant polish which is technically called black, because it reflects no light out of the plane of incidence. In such mirrors as can be wrought by hand, they are worked by short cross strokes on the polisher, and at the same time have a slow rotation relative to it. This might be expected to produce merely a spherical figure; but by varying the length of the stroke, by circular movement, elliptic figure of the polisher, or removing portions of its pitch covering, a parobolic figure is obtained. For sizes above nine inches diameter, the work must be performed by machinery: but in all which Dr. Robinson has seen, (the most remarkable of which are those of Sir William Herschel* and Mr. Grubb,) the cross stroke is given by a lever moved by hand: and it is supposed that perfect results cannot be obtained but by the *feeling* of the polisher's action. Sir John Herschel is believed to have made important additions to his father's apparatus; and it is to be hoped he will soon redeem his promise (Mem. R. Ast. Soc., vol. vi,) of publishing his improvements.

* Dr. Robinson had the good fortune to see this at Slough, in 1830, while at work on a twenty-foot mirror.

Lord Oxmantown has in many respects deviated from the usual process. His polisher, of the mirror's diameter, intersected by transverse and circular grooves into portions not exceeding half an inch of surface, is coated, first, with a thin layer of the common optical pitch, and then with a much harder compound. It is worked *on* the mirror, and counterpoised, so that but little of its weight bears; but the want of pressure is compensated by a long and rapid stroke. The mirror revolves slowly in a cistern of water, maintained at a uniform temperature, to prevent the extrication of heat by friction. The polisher moves slowly in the same direction, while it is also impelled with two rectangular movements. The machine is driven by steam, and requires no superintendence, except to supply occasionally a little water to the polisher, and to watch when the polish is complete. By an induction from experiments on mirrors from six to thirty-six inches aperture, it was found that if the magnitudes of the transverse movements be $\frac{1}{3}$rd and $\frac{9}{100}$th of the aperture, and their times be to its period of rotation as 1 and 1.8 to 37, the figure will be parabolic: but to combine with this the highest degree of lustre, it is found necessary to apply, towards the close, a solution of soap in liquid ammonia, which seems to exert a specific action.

The certainty of the process is such, that the solid mirror of thirty-six inches aperture, after being scratched all over its surface with coarse putty, was, in Dr. Robinson's presence, perfectly polished in about six hours, and was placed in its tube for examination without any previous trial as to quality.

Lord Oxmantown has preferred the Newtonian to the Herschelian form, and, in Dr. Robinson's opinion, with good reason. In the latter, the inclination of the great mirror to the incident rays must deform the image,* and it is now known, that even with faint objects sharp definition is of high importance. It should, in fact, be a segment of a paraboloid, exterior to the axis; and though a theorem of Sir William Hamilton (Trans. Roy. Irish Acad., vol. xv., p. 97) might seem to indicate mechanical means of approximating to the figure, yet Dr. Robinson fears there would be greater difficulty in applying them than in enlarging the aperture of the Newtonian, so as to make up for the loss of light. Another serious objection is, that in the Herschelian the observer's position at the mouth of the tube must cause currents of heated air, which will materially interfere with sharpness of definition.

As to the loss of light by the second reflection, Dr. Robinson thinks it has been much overrated, and expresses a wish that a careful set of experiments were made on reflection by plane specula at various incidences, on prisms of total reflection, and the achromatic prisms, proposed as a substitute by Sir David Brewster.

As to the rest of the instrument, it may suffice to say, that it bears a general resemblance to that of Ramage, but that the tube, gallery,

* Any one who has a Newtonian telescope can verify this, by inclining a little the great mirror, so however as not to pass the edge of the plane mirror by the pencil. In Lord Oxmantown's instrument, an inclination of 11′ sensibly injures it; were it Herschelian, the inclination must be 3° 11′.

and vertical axis of the stand are counterpoised, so that one man can easily work it, notwithstanding its enormous bulk. The specula, when not in use, are preserved from moisture or acid vapours, by connecting their boxes with chambers containing quicklime, which is occasionally renewed. This arrangement (which also occurred to Dr. Robinson, and has been for several years applied by him to the Armagh reflector,) appears to be very effective in preserving the polish.

In trying the performance of the telescope, Dr. Robinson had the advantage of the assistance of one of the most celebrated of British astronomers, Sir James South; but they were unfortunate in respect to weather, as the air was unsteady in almost every instance; the moonlight was also powerful on most of the nights when they were using it. After midnight, too, (when large reflectors act best,) the sky, in general, became overcast. The time was from October 29th to November 8th.

Both specula, the divided and the solid, seem exactly parabolic, there being no sensible difference in the focal adjustment of the eye-piece with the whole aperture of thirty-six inches, or one of twelve; in the former case there is more flutter, but apparently no difference in definition, and the eyepiece comes to its place of adjustment very sharply.

The solid speculum showed α Lyræ, round and well defined, with powers up to 1000 inclusive, and at moments even with 1600; but the air was not fit for so high a power on any telescope. Rigel, two hours from the meridian, with 600, was round, the field quite dark, the companion separated by more than a diameter of the star from its light, and so brilliant that it would certainly be visible long before sunset. ζ Orionis, well defined, with all the powers from 200 to 1000, with the latter a wide black separation between the stars; 32 Orionis and 31 Canis minoris were also well separated.

It is scarcely possible to preserve the necessary sobriety of language, in speaking of the moon's appearance with this instrument, which discovers a multitude of new objects at every point of its surface. Among these may be named a mountainous tract near Ptolemy, every ridge of which is dotted with extremely minute craters, and two black parallel stripes in the bottom of Aristarchus.

The Georgian [Herschel] was the only planet visible; its disk did not show any trace of a ring. As to its satellites it is difficult to pronounce whether the luminous points seen near it are satellites or stars without micrometer measures. On October 29th, three such points were seen within a few seconds of the planet, which were not visible on November 5th; but then two others were to be traced, one of which could not have been overlooked in the first instance, had it been in the same position. If these were satellites, as is not improbable, there would be no *great* difficulty in taking good measurement both of their distance and position.

There could be little doubt of the high illuminating power of such a telescope, yet an example or two may be desirable. Between ε^1 and ε^2 Lyræ, there are two faint stars, which Sir J. Herschel (Phil. Trans., 1824) calls "debilissima," and which seem to have been, at

that time, the only set visible in the twenty-foot reflector. These, at the altitude of 18°, were visible *without an eye-glass,* and also when the aperture was contracted to twelve inches. With an aperture of eighteen inches, power 600, they and two other stars (seen in Mr. Cooper's achromatic of 13.2 aperture, and the Armagh reflector of 15) are easily seen. With the whole aperture, a fifth is visible, which Dr. Robinson had not before noticed. November 5th, strong moonlight.

In the nebula of Orion, the fifth star of the trapezium is easily seen with either speculum, even when the aperture is contracted to eighteen inches. The divided speculum will not show the sixth with the whole aperture, on account of that sort of disintegration of large stars already noticed, but does, in favourable moments, when contracted to eighteen inches. With the solid mirror and whole aperture, it stands out censpicuously under all the powers up to 1000, and even with eighteen inches is not likely to be overlooked.

Comparatively little attention was paid to nebulæ and clusters, from the moonlight, and the superior importance of ascertaining the telescope's defining power. Of the few examined were 13 Messier, in which the central mass of stars was more distinctly separated, and the stars themselves larger than had been anticipated; the great nebula of Orion and that of Andromeda showed no appearance of resolution, but the small nebula near the latter is clearly resolvable. This is also the case with the ring-nebula of Lyra; indeed, Dr. Robinson thought it was resolved at its minor axis: the fainter nebulous matter which fills it is irregularly distributed, having several stripes or wisps in it; and there are four stars near it, besides the one figured by Sir John Herschel in his catalogue of nebulæ. It is also worthy of notice, that this nebula, instead of that regular outline which he has there given it, is fringed with appendages, branching out into the surrounding space, like those of 13 Messier, and in particular, having prolongations brighter than the others in the direction of the major axis, longer than the ring's breadth. A still greater difference is found in 1 Messier, described by Sir John Herschel as "a barely resolvable cluster," and drawn, fig. 81, with a fair elliptic boundary. This telescope, however, shows the stars as in his fig. 89, and some more plainly, while the general outline, besides being irregular and fringed with appendages, has a deep bifurcation to the south.

From these and some other discrepancies, Dr. Robinson thinks it of great importance that the globular nebulæ and clusters should be all carefully reviewed, as it is chiefly from their supposed regularity that the hypothesis of the condensation of nebulous matter into suns and planets has arisen; an hypothesis which he thinks has, in some instances, been carried to an unwarrantable extent.

On the whole, he is of opinion that this is the most powerful telescope that has ever been constructed. So little has been published respecting the performance of Sir W. Herschel's forty-foot telescope, that it is not easy to institute a comparison with *that,* the only one that can fairly be made to compete with it. But there are two facts on record which lead to the inference that it was deficient in defining

power: one, the low power used, which Dr. Robinson thinks was not above 370; the other, the circumstance that neither the fifth nor sixth stars of the trapezium of the nebula of Orion were shown by it. As to light, there is no reason to believe that the composition of the forty-foot mirror was as reflective as that of the twenty foot; and if Dr. Robinson be correct in the opinion, that the latter* did not show the fifth star easily, or the sixth at all, and that it only exhibited the "debilissima" and one star near the ring nebula, then *it* has decidedly less illuminating power than eighteen, perhaps not more than fourteen inches aperture of Lord Oxmantown's mirror, notwithstanding the loss of light in that by the reflection at the second speculum.

However, any question about this optical pre-eminence is likely soon to be decided, for Lord Oxmantown is about to construct a telescope of unequalled dimensions. He intends it to be six feet aperture, and fifty feet focus, mounted in the meridian, but with a range of about half an hour on each side of it. If he succeeds in giving it the same degree of perfection as that which he has attained in the present instance, which is exceedingly probable, it will be indeed a proud achievement; his character is an assurance that it will be devoted, in the most unreserved manner, to the service of astronomy; while the energy that could accomplish such a triumph, and the liberality that has placed his discoveries in this difficult art within reach of all, may justly be reckoned among the highest distinctions of Ireland.

Lond. and Ed. Philos. Mag., Jan., 1842.

Lieutenant Becher's Horizon for Astronomical Observations at Sea or on Shore. Made by CAREY, *Optician, Strand.*

The following is a representation of the sextant, with horizon attached to it for observation:

Directions for attaching the Horizon to the Sextant.

1. Unscrew the cover of the small conical cistern *b*, without removing it from its case, and see that the surface of the oil† in it is *rather higher* than the aperture communicating with the inverted cistern into which the oil is to flow, when holding up the arch of the sextant to read off. Leave the cistern in its place.

2. Take the sextant from its case, and screw the telescope into its place.

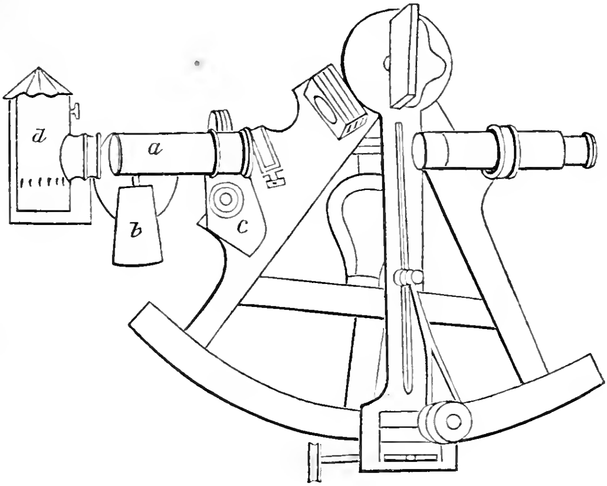
3. Fix the tube *a*, containing the horizon, in its place on the sextant, at the back of the horizon glass, the feet at the back of the plate being inserted in their sockets, and secure it there by means of the screw *c*. Raise the sliding screen at the end of the tube *a* to a proper height, so as to admit a sufficient degree of light to the tube.

4. Hook the cistern *b* in its place at the side of the tube *a*, previously immersing the pendulum in the oil which it contains. Be careful that the pendulum is previously allowed to shake about as

* In its original state, not as improved by the more perfect means latterly employed by Sir John Herschel.

† Oil of Almonds.

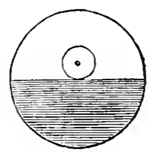
little as possible. The intention of immersing the pendulum in the oil, is to enable the observer to control its movement, which, from the extreme delicacy of its suspension, would otherwise be impossible.



5. If at night, and the lamp *d* be required, having lit the lamp,* if the light be too strong, it may be subdued by placing a screen of paper, or two if necessary, over the colored glass inside its cap, which may be unscrewed for the purpose. There is also a sliding screen† at the end of the tube *a*, which, by being moved up or down, assists in preventing too much light from passing up the tube. The light of the lamp with this also may be reduced to a sufficient strength, so as not to overpower the rays from the moon, or star, on the horizon glass of the sextant. A greater degree of shade may be necessary in bringing down the moon, or star, than afterwards for observation. The lamp being ready, slide its leg into its place at the back of the inverted cistern. The lamp will then hang in its proper place for the observation, and on holding the arch of the sextant up to read off, will preserve its vertical position.

The face of the sextant must never be inclined downward while the horizon with its cistern is attached, as in that case the oil will be lost from it.

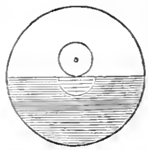
Method of Using the Instrument.—In the construction of the horizon it is assumed that when an observation is made with the horizon of the sea, that horizon forms a diameter to the field of the telescope, the sun being seen on it as in the adjacent figure. The long axis of the telescope fixed in the instrument, would then



* Four threads are sufficient for the wick.

† This screen being raised or depressed regulates the degree of light also for day observaion, and at a proper height will prevent a burr on the horizon arising from too much light.

be horizontal, but for the known angle of the dip of the horizon, by which the altitude is corrected. The same position of the telescope is thus obtained:—A line for the horizon formed by the upper edge of the slip of metal, at right angles to the plane of the instrument, and in the plane of the axis of the telescope, was assumed beyond the horizon glass, and a small pendulum, carrying an arm at an angle of 90°; to which was fixed another slip of metal, the upper edge of which is at right angles to the pendulum, was placed beyond it. The pendulum having free motion in any direction, the observer has to bring the upper edge of the slip of metal attached to the pendulum in exact contact with the line above mentioned, or in other words, he has to bring the upper edges of the two slips of metal into one, and at the same time he is to make his observation by bringing down the image of the reflected object which he is observing upon it. If that object be the sun, it will appear thus:—



As the observer has thus to form his horizon at the instant of observation, in observing on board, he should get into that part of the ship where there is the least motion, and *especially in a place screened from the wind.* He may be seated or not, at pleasure, but he will find that he has more control over the movement of the pendulum when the arm holding the instrument is supported on his knee, or by some convenient part of the vessel. In observing *on shore,* he must also be careful to *screen himself from the wind.*

The observer will readily see when the upper edge of the slip of metal is below the line of the horizon, and by altering the position of the instrument, can bring the former up to the latter; but as the metal slip would prevent the horizon line being seen when the upper edge is above it, a small piece has been cut out of it, or, in other words, a notch, or aperture, has been made in this edge, so that the observer can see the horizon line in that aperture, when the horizon line is below that edge, and can rectify it by again altering the position of his instrument.

It may be right to state here that the great precision attainable with this horizon, may be attributed to the application of the lens at the end of the tube, next the horizon glass, which allows of the magnifying power of the telescope being used for the observation.

Naut. Mag. Aug. 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1841.
With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Press;* William C. Van Hoesen, Catskill, Greene county, New York, April 2.

A shaft runs across the frame of this press, and on each end of it there is a scroll wheel, which receives a chain, or rope, that passes

around a pulley at the top of the frame, then under another pulley, attached to each end of the follower, and is then made fast to the upper part of the frame. On one end of the shaft of the scroll wheels there is a large wheel, called the "power wheel," from which a chain, or rope, passes to a capstan, or other first mover.

The claim is to the "combination of the power and scroll wheels."

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2. For an improvement in the *Current Water Wheel* for Mills; Noadiah N. Hubbard, Randolph, Portage county, Ohio, April 2.

This patent was obtained for an improvement in the manner of applying chutes to the spiral current wheel. Heretofore two chutes have been placed at the forward part of the screw, so as to concentrate the current; but in all cases the current thus concentrated has been thrown upon the first thread of the screw, and the present improvement is in so placing these chutes that the current shall be directed upon different parts of the length of the thread. The patentee says: "I am aware that the force of the current to be thrown upon a wheel has been increased by chutes placed at an angle with the axis of the wheel, so as to concentrate the current upon it, and this I do not, therefore, claim as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the employment of two or more sets of chutes, or regulators, in combination with a spiral wheel, so as to throw the current upon different parts of the thread, or spiral, along its length, as described."

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3. For a method of *Wetting Flannels and other Cloths* previous to Scouring or Milling; Joseph W. Hale, Haverhill, Massachusetts, April 2.

A colander, pierced with numerous small holes, is attached to a reservoir, or tank, of water, by means of a pipe, the orifice of which is regulated by a valve, to which a cord is attached having a weight at its opposite end, for the purpose of keeping the valve opened when desired. A roller is placed at one end of the frame, and two at the other end, and the cloth in going from the single roller to the double set, by which it is drawn through regularly, passes under the colander and receives the spray from it.

The claim is to the combination of the tank, or reservoir, valve, rollers, and the colander.

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4. For improvements in the machine for *Cutting Crackers;* William Perkins, Boston, Massachusetts, April 2.

A shaft that runs across the frame of the machine gives motion to another shaft, on which is a segment cog wheel that takes into a cog wheel on an under feed roller, and from this motion is communicated to the upper feed roller, and the apron that carries the dough under the stamping apparatus, and conveys the cut crackers from under it. As the wheel that communicates motion to the under feed roller has cogs only on a part of its circumference, the dough will be fed at in-

tervals, and those intervals are made to correspond with the time required to stamp the crackers, which is effected by a cam on each end of the shaft of the segment wheel, said cam actuating a lever connected, by a rod, with a toggle-joint that operates the stamping apparatus.

The claim is to "the arrangement of machinery which gives motion to the feed rollers and endless apron, in combination with the arrangement of machinery which operates the stamping apparatus; and also to operating the feed rollers and endless apron, so that they may be alternately at rest and in motion, by means of a geared pinion, having a portion of the teeth of its circumference removed, in connexion with the other machinery intervening between said pinion, feed rollers and apron; also operating the stamping apparatus by means of a cam or cams, in connexion with the toggles and other intervening machinery."

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5. For an improvement in the *Tuyere for Forges;* Elias Kaighn, Camden, Gloucester county, New Jersey, April 2.

The ash box of the forge is to be surrounded by a flue, which has an opening to receive the nose of the bellows, and the blast passes from the flue into the ash box, through apertures made in the sides thereof, and from the ash box into the fire, through holes made for that purpose in its top plate; the ash box has a bottom which is removable at pleasure.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the construction of the tuyere with a flue surrounding the ash box, in combination with said ash box, as set forth. Also, in combination with the foregoing, the arrangement with the upper surface of the tuyere, as the hearth of the forge, and the perforated cover for admitting air to the flame, &c., as set forth."

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6. For a *Cattle Pump;* Shively Stadon, Greenwood, Columbia county, Pennsylvania, April 2.

The patentee says:—"In my apparatus the weight of a single animal, or of more than one, is made effective in the raising of water, by their standing upon a movable platform, close to which the trough is situated, from which they are to drink, said platform being so connected with a pump as that by its depression it shall operate upon the pistons of the pump, and of course give a supply of water."

The claim refers throughout to the drawings, and is confined to the special arrangement of the apparatus, as described and represented.

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7. For a mode of *Healing Reducible Hernia;* Zophar Jayne, M. D., Greene county, Illinois, April 2.

The claim affords a sufficiently clear description of the improved mode of healing reducible hernia, and is in the following words:

"What I claim as my invention, and desire to secure by letters patent, is, first the injecting into the hernial or peritonial sac, or into the common cellular membrane, or parts in, at, or about, the abdominal

or femoral rings, or openings, wherever the hernia may occur, of an essential oil, or other stimulating or exciting fluid, for the purpose herein fully set forth, whether the same be done or injected by means of the syringe herein described, or by any other instrument adapted to that purpose; and secondly, I claim the constructing and using of a syringe for the above purpose, having a sharp-pointed beak, and a lateral opening therein, substantially as described.

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8. For an apparatus for *Heating Water and Steaming Vegetables;* Asa Munger and James S. Marsh, Auburn, Cayuga county, New York, April 2.

This apparatus consists of a boiler made of two concentric cylinders, the space between the two being for the water, and the furnace being arranged within the inner cylinder. A tubular worm is coiled within the first chamber, its upper and lower ends opening into the boiler. Two tubes branch off from the boiler, one from the top and the other from near the bottom, and connect with the bottom of a tub, from which the steam is conveyed, by a pipe, to the steaming apparatus.

Claim.—"We do not claim to be the inventors of the worm in the fire chamber, nor of the combination of the tub and boiler, without the worm, but what we do claim as our invention, and desire to secure by letters patent, is the combination of the worm in the fire chamber with the boiler and tub, for the purpose and in the manner set forth."

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9. For an improvement in the *Joints of Spectacle Frames;* Thomas Eltonhead, Baltimore, Maryland, April 2.

"It has heretofore been the practice in forming the frames of spectacles of metal to divide the end-pieces, which are soldered to the rims containing the glasses into two parts, and to connect these two parts together by means of a screw. The joint pin has been affixed to one of these parts, and the side, or temple pieces, have had the tubes through which the joint pin passes soldered to them. In my improved construction I make the end pieces solid, instead of dividing them into two parts, and into this solid piece I file a notch, to receive the end of the temple piece, which is to be adapted thereto, and a hole drilled through for receiving the joint pin."

The claim is to this manner of forming the joints, which not only abridges the labor in making them, but leaves the metals in a condensed state, it not being heated after, having been hardened under the hammer. The glasses are to be snapped in like watch glasses.

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10. For improvements in *Corselets for Medical purposes;* Alanson Abbe, Worcester, Massachusetts, April 2.

The patentee informs us that "the corselet consists of a back piece, and two side pieces, which are united to, and open from, the back piece by a hinge of metal, cloth, or other material, fixed at the top,

and in front are laced with strings. These are made, when connected, to enclose the breast, shoulders, and the upper part of the back, and are adjusted to the shape of the wearer, so as to represent the figure of the body of a well formed person. The corselet affords a support to the frame, and may be advantageously used to prevent, or remedy, distortions of the spine or chest."

The respective parts of the corselets are formed in a mould of metal, wood, plaster, or other suitable material, of the desired form. The claim is to the "mode of manufacturing corselets by forming them of any suitable material upon a mould, or between double moulds, as specified."

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11. For an improvement in the *Cheese Press;* Job Arnold, Harmony, Chataque county, New York, April 2.

The bed of this press is movable, as is also the follower. The bed slides up and down, and has a cog wheel, or pinion, at each end, the axes of which wheels have their bearings in the bed; these wheels gear into two permanent racks attached to the sides of the frame, and as the bed of the press slides up and down, the cog wheels, or pinions, are turned by the racks. There are two levers under the bed, and two above the follower of the press. The levers above, and those below, are connected together by rods, or links, joined to one of their ends, the other end of each pair being connected, by means of ropes, or chains, with the arbor of the cog wheel on each side of the bed. The fulcra of the upper levers are in the follower, and those of the lower, in the bed of the press. The result of this arrangement is, that any weight placed on the movable, or sliding, bed, will cause it to descend, which will turn the wheels, and by means of the ropes, or chains, on their arbors, the ends of the levers to which the chains are attached are drawn together, and as their opposite ends are connected together, the follower is forced down upon the cheese, or other articles placed on the bed.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the combining of two sets of levers, one set being arranged above the follower, and the other below the movable bed, or press bottom, with the aforesaid follower and movable bed, and said levers being connected and operated as set forth."

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12. For improvements in the *Rotary Steam Engine;* Isaac N. Whittlesay, Vincennes, Knox county, Indiana, April 2.

"The general construction of my improved engine," the patentee says, "is similar to that of some others which have been heretofore constructed, but I have made such improvements thereon as are intended and calculated to obviate some of the difficulties which have been experienced in its action. The principal of these improvements consist in the employment of the steam to open and close the sliding valves, and in the arrangement of some of the other parts by which its action is governed."

Within a hollow case, of the usual construction, "revolves a drum, which carries two valves, to be operated by the action of the steam, which action causes the said inner drum, with its shaft, to revolve in the ordinary way. The valves, which are connected together by a rod, slide into recesses made for them in the drum, which is hollow towards the shaft, for the reception of a disk attached to one of the heads of the outer drum. This disk is at some distance from the head plate to which it is attached, and the space between them is divided by a partition, so as to divide the induction from the eduction pipes. The steam introduced through the induction pipe passes into the hollow space of the inner drum, acts against the inner end of one of the valves, which is thus forced out, and then passes through a hole by the side of the valve into the steam chamber, and impels the valve and inner drum by its reaction on a stop attached to the inner periphery of the outer drum. The openings which admit the steam into, and allow it to escape from, the drum, must be so regulated as to correspond with the position of the stop. The steam may be made to enter the space between the two drums on either side of the valves by a shifting plate, which opens an aperture on one side as it closes the one on the other side, so that by shifting this plate, the motion of the engine may be reversed. The claim refers throughout to the drawings. It is confined, however, to the manner of protruding the valves by the elastic force of the steam, acting behind them by an arrangement of parts similar to that above described; and also to the manner of reversing the motion of the engine, by shifting the plate, as above indicated.

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13. For an improvement in the machine for *Cutting Staves;* Cephas Manning, Acton, Middlesex county, Massachusetts, April 10.

This machine cuts the staves from a block of wood by means of a knife, or knives, attached to two revolving disks on a shaft. Between the knife and the shaft there is a bar, extending from disk to disk, on which two holders are placed, armed with the necessary cutters for forming the bevel and groove, and for cutting off the ends of the staves. The position of these holders may be shifted on the bar, so as to adapt them to any length of staves, they being made fast by means of a set screw. The bar should be so situated, with reference to the cutter, which separates the stave from the block, as to cut the bevel, &c., before the stave is cut from the block.

The block is moved forward by means of levers, palls, and a ratchet wheel, which need no description, and these are so arranged as to be thrown in and out of gear, at pleasure, by the aid of levers and catches.

Claim.—"I claim the arrangement of the holders of the cutters for forming the bevel and groove, and for cutting off the ends of the staves, on curved or straight bars, or similar contrivances, so that they may be adjusted to cut staves of different lengths, and preserve the bilge of the stave, as described."

The particular arrangement of the machinery by which the pall and ratchet wheels are thrown out of gear, is also made the subject

of a claim, but this we omit, as the drawings would be necessary to an understanding of it.

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14. For improvements in *Lamps* for burning Chemical mixtures, or compositions of Alcohol, Spirits of Turpentine, &c.; Benjamin F. Greenough, Boston, Massachusetts, April 10.

The claims express the character of the improvements sufficiently to enable any one acquainted with the construction of lamps to understand them. They are as follows:

"Having described my invention, I shall claim—first, the placing of a shoulder on the rod by which the button is supported, said shoulder being so constructed as to set loosely on, and adapting the button to a projection on said shoulder in a similar manner, by means of which combined arrangement, the rapid oxidation of the disk (which is made of platina,) is prevented, as described. Second, guiding the adjusting rod of the button, by passing the same through a tube, whose lower end is attached to the bottom of the oil cup, or otherwise similarly arranged, the said tube extending upwards into and through the central part of the interior of the burner, the whole being for the purpose of permitting an uninterrupted current of air to act on the inner surface of the flame. Third, the combination of an adjusting cone (applied to the exterior tube of the burner by a circular spring, or other contrivance substantially the same, by which its altitude is regulated,) with the adjusting button, or one whose elevation may be varied at pleasure; the whole being arranged substantially in the manner and for the purpose described. Lastly, I claim a cone constructed with an extended cylindrical base, having a series of radial holes through the circumference of the same, and made so as to be adjusted in height on the exterior tube of the burner by means of a circular shelf and spring, in combination with a movable button, whose rod is supported and guided by a tube, connected with the oil cup, and whose elevation can be regulated by a screw, or other suitable contrivance, the whole being constructed and arranged for the purpose and in the manner described."

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15. For a machine for *Harrowing and Planting Seed;* John F. Schermerhorn, and Rufus Porter, City of New York, April 10.

In an appropriate frame there is a cylinder, armed with several rows of curved teeth, which enter, and carry up, the earth, and this is knocked off by the teeth of a smaller cylinder, which pass between the sets of teeth on the main cylinder. At a short distance back of the said small cylinder, there is a planting cylinder, hoppers and coverers, to contain, drop, and cover the seeds. For the purpose of lifting the forward part of the machine, to clear the teeth from the ground, there are two shoes jointed to the frame, and to two levers that are connected together by a bar, by which arrangement the shoes may be pressed down and made to lift the machine.

Claim.—"What we claim as our invention, and wish to secure by letters patent, is combining the large, or cutting, cylinder, and the re-

volving shaft of spiders, arranged as set forth in an open frame, so constructed as to allow of their application to the purpose specified, and described. We also claim, in combination with the foregoing, the hoppers and planting cylinders, the whole being constructed as described. Lastly, we claim, in combination with the cylinder and shaft of spiders, arranged as set forth, the mode of raising the frame and cylinders from the ground by means of the shoes and levers; the whole being combined, arranged, and operating substantially as described."

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16. For an improvement in the *Truss* for the cure of Prolapsus Uteri; John A. Campbell, Lima, Livingston county, New York, April 10.

There is in this truss a body spring, of the usual construction, furnished with a back pad. The abdominal pad is connected with the body spring by means of a semi-elliptic spring, which is attached to the rim of the pad at one side, permanently, and at the other by a screw which passes through a slot in the elliptic spring, so as to allow play thereto. To the middle of this semi-elliptic spring, and to the upper part of the pad rim, is attached the adjusting plate, which forms the connexion with the body spring, the screw which connects them being passed through a slot in the said plate, for the purpose of adjustment.

Claim.—"I do not claim as my invention either the abdominal or the back pad, neither do I claim the body spring; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement of the semi-elliptic spring and the spring adjuster, in combination with the abdominal pad, body spring, and back pad, for the purpose of regulating the pressure of the abdominal pad, constructed and operating as described."

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17. For an improvement in the *Window Blind Fastener;* Sylvanus Fansher, Southbury, New Haven county, Connecticut, April 10.

This apparatus consists in part of a bar, which is jointed to the shutter, near its hinged edge; the outer end of this bar has a loop which passes on to staples attached to the window sill, and to the shutter—those on the shutters are near the edges that lap over each other, and correspond, when the shutters are closed, with two on the sills, so that the loop on the end of the bar may pass over and embrace the two, and thus secure the shutters. When it is desired to keep the shutters open, the loops on the bars are passed on to staples near the sides of the window.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the above described mode of fastening window shutters and blinds, which consist of the bar attached by a joint to the shutter, in combination with the two sets of staples on the window sill, and the one set on the shutters.

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18. For an improvement in the method of *Casting Hinges;* Samuel Wilkes, Darleston, Stafford county, England, April, 10, 1841. Patent to run fourteen years from the 21st of January, 1840, this being the date of the English patent.

This patent is for a mode of casting the two sides, or flaps, and the hinge joint on to an axis at the same operation. A wrought iron joint pin is put into the mould, and, in casting, the metal is prevented from running together at the joints, by iron or paper washers slipped on the joint pin; and the junction of the leaves between the joints is prevented, by means of iron clips, put into the flasks.

Claim.—"What I claim is the mode of manufacturing hinges, by casting the two flaps, or sides, with their hinge joints at one time, on to a suitable axis, as described."

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19. For an improvement in the machine for *Pressing Straw Braid;* Henry H. Robbins, Middleborough, Plymouth county, Massachusetts, April 10.

For an explanation of the leading features of this improvement, we refer to the claim only, which is in the following words, viz:—"I claim as my invention," says the patentee, "pressing straw braid by means of a polished revolving metallic wheel, or roller, in combination with a hollow metallic box, the upper side, or face, of which is concave and polished, and which is heated by the introduction of steam, the concave face being pressed against the periphery of the wheel by means of a bent lever and weight."

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20. For an improvement in the *Screw Propeller*, for propelling Boats, Vessels, &c; Ebenezer Beard, New Sharon, Franklin county, Maine, April 10.

A description of the peculiarities of this improvement could not be rendered clear without the drawings; but the claim will enable those who are acquainted with the screw propellors heretofore made, to understand this modification.

Claim.—"I shall claim" "curving the wings of the screw paddles, or propellers, in a direction perpendicular to the shaft, or axis, of revolution, as described."

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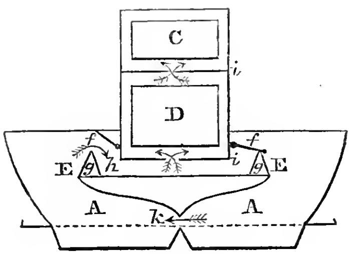
21. For improvements in the *Cooking Stove;* M. C. Saddler, Brockport, Monroe county, New York, April 10.

In this stove there are two fire chambers, A A, (see diagram,) placed side by side, and two ovens, C D, one above the other, and placed above the fire chambers, the side flues of the oven being above the middle of each fire chamber, and that portion of each fire chamber which is not covered by the ovens, is provided with boiler holes in the usual way. The bottom of the lower oven



protected from the action of the fire by a cold air flue, as will be en by reference to the diagram, at E E, the bottom plates of which e curved down where they meet in the middle between the two fire ambers, and leave but a narrow space, *k*, between them and a pro- ction from the bottom plate of the fire chamber. The valves, or mpers, *f*, *f*, are hinged to the side plates of the ovens, and bear, ien closed, on the top of hollow valve seats *g*, *g*, through which cold circulates, for the purpose of protecting them from the injurious ion of the fire; but when the dampers are open, a flue is formed by surface of the damper, the top plate of the fire chamber, and the e of the oven, as at *h*, into which cold air is admitted for the same rpose.

Between the top plate of the cold air chamber and the bottom of lower oven, and between the top of the bottom, and the bottom of top oven, there are guard plates, *i*, *i*, which admit the draft under middle of the bottom of the oven. Fire can be made in one or h fire places; when one only is used, one of the dampers must be sed.

Claim.—"I do not claim to be the first to have constructed a cook- stove with two fireplaces, or chambers of combustion, in either ooth of which fire might be made, this having before been done, not under an arrangement and combination of parts similar to t adopted by me; but what I do claim in the above described stove, l desire to secure by letters patent, is the manner of constructing l of placing the cold air flue between the chambers of combustion l the ovens situated above and between said fire chambers, as ein set forth. I claim, likewise, the making of the valve seats hol- r, and the admitting of air into them, in the manner and for the rpose described; and also the protecting of the dampers, by consti- ing the spaces formed by them, when opened, into cold air flues, the manner set forth. I also claim the manner of arranging the n flues as described—that is to say, the dividing of the bottom flue tes, which I generally denominate the guard plates, into two parts, as to cause the heated air to enter the flues along the middles of bottom oven plates, and to ascend on each side of the ovens, as ein made known."

For improvements in the machine for *Planting Corn*, Sugar Beet, and other seeds; Ezra L. Miller, Brooklyn, New York, April .0.

On the forward end of the frame of this machine, and at each side it, there is a hopper, furnished with a slide for receiving and drop- g the seeds. The slides are connected by a small chain with a spi- spring, inclosed in a tube, which draws back the slides after they ve been pushed forward by cams on the wheels of the machine, ich strike against a lever in connexion with each slide. When slides are relieved from the cam, they are drawn back by the ing, and strike against a stop, which gives a jar to insure the drop- g of the seeds. The strike, which brushes off the surplus seeds from

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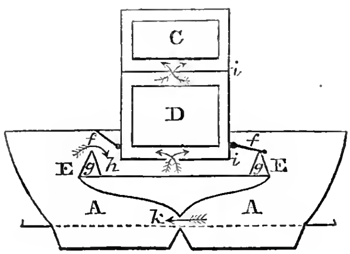

is protected from the action of the fire by a cold air flue, as will be seen by reference to the diagram, at E E, the bottom plates of which are curved down where they meet in the middle between the two fire chambers, and leave but a narrow space, *k*, between them and a projection from the bottom plate of the fire chamber. The valves, or dampers, *f*, *f*, are hinged to the side plates of the ovens, and bear, when closed, on the top of hollow valve seats *g*, *g*, through which cold air circulates, for the purpose of protecting them from the injurious action of the fire; but when the dampers are open, a flue is formed by the surface of the damper, the top plate of the fire chamber, and the side of the oven, as at *h*, into which cold air is admitted for the same purpose.

Between the top plate of the cold air chamber and the bottom of the lower oven, and between the top of the bottom, and the bottom of the top oven, there are guard plates, *i*, *i*, which admit the draft under the middle of the bottom of the oven. Fire can be made in one or both fire places; when one only is used, one of the dampers must be closed.

Claim.—"I do not claim to be the first to have constructed a cooking stove with two fireplaces, or chambers of combustion, in either or both of which fire might be made, this having before been done, but not under an arrangement and combination of parts similar to that adopted by me; but what I do claim in the above described stove, and desire to secure by letters patent, is the manner of constructing and of placing the cold air flue between the chambers of combustion and the ovens situated above and between said fire chambers, as herein set forth. I claim, likewise, the making of the valve seats hollow, and the admitting of air into them, in the manner and for the purpose described; and also the protecting of the dampers, by constituting the spaces formed by them, when opened, into cold air flues, in the manner set forth. I also claim the manner of arranging the oven flues as described—that is to say, the dividing of the bottom flue plates, which I generally denominate the guard plates, into two parts, so as to cause the heated air to enter the flues along the middles of the bottom oven plates, and to ascend on each side of the ovens, as herein made known."

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22. For improvements in the machine for *Planting Corn*, Sugar Beet, and other seeds; Ezra L. Miller, Brooklyn, New York, April 10.

On the forward end of the frame of this machine, and at each side of it, there is a hopper, furnished with a slide for receiving and dropping the seeds. The slides are connected by a small chain with a spiral spring, inclosed in a tube, which draws back the slides after they have been pushed forward by cams on the wheels of the machine, which strike against a lever in connexion with each slide. When the slides are relieved from the cam, they are drawn back by the spring, and strike against a stop, which gives a jar to insure the dropping of the seeds. The strike, which brushes off the surplus seeds from

the top of the slide, as it is moving forward to drop them, is composed of a number of strips of quills, held together in a clamp. An agitator is employed to insure the entrance of the seeds in the hole in the slide, and to prevent them from arching over, which consists of a rod, with a brush at one end, which is jointed, and by means of a rod, or standard, attached to, and moving with, the slide and a connecting rod, this brush, or agitator, is moved over the hole in the slide.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is—first, the manner in which I have combined the reciprocating slide, the stop, the cams on the wheels, and the spring, or springs, by which the slides are operated; by means of which combination, an alternately slow and rapid motion is given to the reciprocating slide, by the sudden arresting of which against the stop, a concussion is produced when the seed vessel is directly over the dropping tube, which insures its falling. I also claim the particular construction of the spring strike, formed of elastic quills, and affixed and operating substantially as described. I also claim the manner of constructing and operating the agitator, as described."

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23. For a mode of *rendering Casts and other articles Water and Air Proof;* Samuel Goodwin, city of New York, April 16.

This invention "consists in making any article that can be cast, or moulded, perfectly impervious to air, moisture, or decay, by saturating it in a heated composition of oil and rosin. What I claim as my invention, and desire to secure by letters patent, is the mode of rendering articles manufactured from cement, composed of the materials specified, (sand and plaster of paris,) or any others substantially the same in their combination, impervious to air, moisture, or decay, by boiling them in a mixture of oil and rosin, as described." Casts of plaster of paris, and its compounds, have often been saturated with wax, drying oils, and varnishes, and in what particular the proposed process differs from these, we do not know, except it be in the *boiling*, which, we apprehend, will be apt to decompose the plaster, by separating from it its combined water.

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24. For an improvement in the *Indicator, or Steam Gauge,* for ascertaining the pressure of steam in a boiler; George Bradley, Paterson, Passaic county, New Jersey, April 16.

This apparatus consists of a piston, which works in a cylinder open at one end to the atmosphere, and at the other to the steam in the boiler, and this is connected, by a slide, to a spring balance, provided with a graduated scale and pointer, to indicate the pressure of the steam in the boiler above that of the atmosphere.

Claim.—"What I claim as my invention, and not previously known nor used, is an oscillating piston, to which is attached a metallic spring, in such a manner as to counterbalance any pressure that may be communicated from the steam boiler to such piston, and at the same time show what that pressure is by means of an index."

25. For an improvement in the *Cooking Stove;* John B. Bissell, Otsego, New York, April 16.

This stove has two fire chambers—one in front of, and the other above, the oven. When the front alone is used, the draught passes, by means of raised flues, under the boilers, through the upper fireplace, and out at the stove pipe; or, by means of a rolling damper, which closes the opening to the upper fireplace. and at the same time opens the flues around the oven, it may be carried down in front of the oven, under it, and then up the back, to the stove pipe. The draught from the upper fireplace may pass either directly out of the stove pipe, or down the back of the fireplace, over the oven, down the front, under the bottom, and up the back, to the stove pipe.

Claim.—"I do not claim the invention of the raised collars, or rolling or slide dampers, or either of the fire chambers, they, severally, having been used before, in different stoves: but I do claim as my invention and improvement, the method of arranging and combining the upper and lower fire chambers with each other, and with the flues around the oven, by means of flues governed by dampers."

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26. For improvements in *Saw Mill Dogs;* Damon A. Church, Friendship, Alleghany county, New York, April 16.

In this case we omit the claim, as it refers throughout to the drawings, and could not be understood without them. It is limited to an arrangement of levers for withdrawing the dogs by the motion of the carriage, and also to a particular arrangement of the parts for setting the log.

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27. For an improvement in *Knife Handles;* Zena K. Murdock, Meriden; New Haven county, Connecticut, April 16.

The subject of this patent is a new mode of making handles for table cutlery, from plates of ivory instead of from solid pieces. Four such plates are to be put together by tongues and grooves, and held in place by a cap at the back end, and by a ferule at the end which receives the knife or fork.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode or method of constructing handles for table cutlery from plates of ivory, or bone, &c., combined substantially in the manner specified."

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28. For an improvement in the machine for *Cleaning and Drying Feathers;* Nathaniel L. Manning, Boston, Massachusetts, April 16.

The patentee says: "I shall claim as my invention the mode herein described of drying and cleansing feathers, by means of carbonic acid gas, hot air, and other products of the combustion of charcoal, or other suitable fuel, introduced among the feathers during the process of whipping and separating them from each other, in the manner described. Second, I claim whipping and separating the feathers from each other, by means of bows and sails applied to a revolving shaft,

which shaft shall remain in one position, while revolving, and the feathers be brought under the action of the same, in the box in which said shaft revolves, in any convenient manner, or said shaft may be moved over the mass of feathers, and back and forth throughout the box, by means of a band and pulley, or a chain belt and cogged pinion, operated as above described. Third, I claim closing the elongated slots, or apertures, in the sides of the box, so that none of the feathers may escape, or impede the operations of the machinery, as the revolving shaft is moved to and fro, by means of a band laying over the same, and traveling over drums, or pulleys, and operated by the revolving shaft, as set forth."

We deem it unnecessary to add any explanatory remarks, as the alleged improvements are sufficiently pointed out in the above; we have no doubt that this machine will be equally good with some of the previously patented feather dressers, which have had their day, and are almost forgotten.

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29. For an improvement in the *Screw Wrench;* Loring Coes, Springfield, Hampden county, Massachusetts, April 16.

The following is the claim made under this patent. "Having thus described my invention, I shall claim combining the screw, which operates the sliding jaw (and which is placed on one side of the shank upon which the said jaw moves, and to the extremity of which the hammer jaw is applied;) with a female screw formed through a projection from the sliding jaw, situated on the same side of the shank with the adjusting screw; the said adjusting screw to be suitably supported, and to have a turning, or milled, nut thereon, a portion of whose edge, or periphery, shall pass into a notch or other similar contrivance, formed in, or upon, the side of the shank of the wrench, so that the said adjusting screw may be always kept in the same position, and when revolved, cause the lower jaw to slide on the shank, as described."

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30. For improvements in the *Pump;* Jesse Reed, Marshfield, Plymouth county, Massachusetts, April 16.

Claim.—"Having described my improvement in pumps, I shall claim: First.—The method of confining the lower valve to its seat, so that it may be easily removed therefrom, for repair or other purpose, by means of a spring, to which the valve is connected, and which rests on the upper surface of the bottom of the pump barrel—its end pressing against the interior circumference of the barrel, the same being arranged and constructed substantially as described. Second.—I claim the particular mode, above described, of constructing a pump, with an air chamber below the lower box, into the bottom of which chamber the pipe communicating with the cistern, or well, is inserted, or connected, in any proper manner, and through which chamber another pipe passes, the lower end of which is situated immediately over the top of the induction pipe, while the upper

end is joined, or connected, to the top of the chamber, the said pipe communicating at top, with the pump barrel, the lower valve of the same being immediately over and upon its ends, and at bottom, by any sufficient number of holes, or orifices, bored through the same, with the said chamber, through which it passes, the whole being arranged substantially as described, and for the purpose of permitting the water, from the cistern, or well, to rise into the chamber during the downward stroke of the piston, or upper box, and otherwise operating in manner as herein before explained and set forth; meaning in the above, not to claim the addition of an air chamber to the lifting pump, but my particular mode of constructing and applying the same, as described. Third.—I claim the method of adjusting the pump handle, or lever, which raises and depresses the upper pump box, by attaching said lever to the top plate, or cover, of the pump barrel, and arranging said plate, or cover, as described, so that it may be turned around, and fixed in position by a screw or other similar, or suitable, contrivance, the whole being constructed and operating substantially as described."

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31. For an improvement in the *Dyeing Machine;* William Spencer, Lowell, Middlesex county, Massachusetts, April 17.

This improvement in the dyeing machine has been added to a patent granted on the 25th of September, 1838, noticed in this Journal, vol. xxiv, 2nd series, page 168; for an explanation of the principle of the machine, the reader is referred to that article.

Instead of one vat, as described in the original patent, there are to be several successive vats, and a slatted reel for each vat, said reels being so arranged that, by means of counter weights, cords, and pulleys, they may be drawn out of the vats. The yarn passes from the beam over a small slatted reel on the edge of the vat, down through the dyeing liquor under the slatted reel, then up over another small reel on the other edge of the vat, then through a comb down under a reel between the vats, over a small reel on the edge of the next vat, and so on through the series. When the operation commences, the liquor being strong, some of the reels are drawn out, so that the yarn is not passed through all the vats, and as the dyeing liquor becomes weaker, the reels are let down into the vats, one after the other. The yarn is passed under reels between the vats, to expose it to the action of the atmosphere. The claim made is to the variations in this arrangement, from those described in the original patent.

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32. For an improvement in the manner of constructing the rods of *Lightning Conductors;* Justin E. Strong, Boston, Massachusetts, April 19.

The claim made under this patent is to "the mode set forth of connecting the joints of lightning conductors, and constructing and applying the discharging points thereto; that is to say, by forming each point with a shoulder and a shank in rear of the same, the said shank

having a screw cut on the same, and passing through one of the rods, and being screwed into the other, the whole being arranged and applied to a building as described."

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33. For an improvement in the *Smut Machine;* William B. Palmer, Rochester, Monroe county, New York, April 19.

In this machine, two frustrums of cones, made of perforated sheet metal, are arranged one within the other, the interior frustrum being made to revolve. The upper surface of the head of the inner cone, and the inner surface of the head of the outer one, are fluted, for the purpose of rubbing the grain; and within the inner cone, there is a fan which revolves in a direction contrary to that of the cone. The grain is fed in from the top and rubbed between the surfaces of the two cones, and is at the same time subjected to the action of a current of air, created by the fan.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following improvements, viz: The combination of the fan with the cones, in the manner set forth; the internal cone being perforated, and constructed with a fluted head, and having the fan arranged and moved within it, as described; also the combination of these, so constructed and arranged, with the external cone."

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34. For an improvement in the *Screen for Sifting Coal;* Elisha D. Payne and Enos Woodruff, Newark, Essex county, New Jersey, April 19.

The patentees say,—"Our improvement consists in a new method of hanging the sifting box by means of two gudgeons, or by a single rod, or axle, and providing a guide board on the sifting box, to guide the material to be sifted on to the head of the screen. We give to the screen a peculiar shape, which forms the under part of the sifting box, and incline it from its head to its delivery end to suit the nature of the material sifted. The axle, or gudgeons, we place about one-third of the way from the head of the sifting box to the tail, or delivery end, and we agitate the sifting box by raising or depressing the one end, by means of a cam toothed wheel, with a spring at the other end to return the motion against the toothed wheel, so that it is vibrated vertically, like a tilt hammer."

"What we claim, is combining the inclined guide board with a box, or case, for receiving the material to be sifted, constructed as described; said box consisting of side and end pieces, and an inclined bottom, pierced with apertures for sifting the coal, or other materials, the whole being arranged as set forth. Also, in combination with the sifting box thus constructed, an exterior case for containing the same. Lastly, in combination with the sifter box and external case, the method of suspending and operating the shoe by means of the axle, the spring, and wheel, the whole being constructed and operating in the manner set forth."

35. For an improvement in the *Seal Press;* A. Ralston Chase, Cincinnati, Ohio, April 19.

In this press the seal is to be attached to a guide rod, around which is coiled a helical spring, for the purpose of drawing up the guide rod and seal, after they have been relieved from the action of an eccentric, or cam, on the end of a hand lever, by which the impression is given.

The claim is confined to the "combination of the lever, having an eccentric formed on its end, with the guide rod, and helical spring, as described." The difference between this seal press and many others previously in use, is very small, and its superiority to them by no means obvious.

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36. For an improved mode of producing a *Black Color for Dyeing;* John D. Prince, Lowell, Middlesex county, Massachusetts, April 24. (See Specification.)

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37. For an improvement in the *Spring Lancet;* John M. Van Osdel, Chicago, Cook county, Illinois, April 24.

The stem of the lancet which is the subject of this patent, is jointed to the back part of the inside of the case, and by means of two bridle pieces, it is connected to one end of a rod, which passes out through the back of the case; and around which is coiled a helical spring, for the purpose of drawing back the said rod. The two bridle pieces constitute what is called the "toggle joint," the vibration of which from one side to the other, which is effected by means of the rod and spring, will cause the lancet blade to advance so as to enter a vein, and then recede. The lancet is set by means of a nut on the rod which regulates the amount of vibration of the toggle-joint.

"What I claim as my invention, and desire to secure by letters patent, is the giving a reacting motion to the blade of a spring lancet, by the combination of the spiral spring and the compound cranks, or bridle pieces, as set forth. Also, I claim the method of setting the lancet by simply drawing back the rod, as described."

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38. For an improvement in *Boots and Shoes;* Ansel Thayer, Braintree, Norfolk county, Massachusetts, April 24.

"In boots and shoes as improved by me, there is not any outsole of leather from the instep to the back of the heel, this part being occupied by a plate, or fixture, of metal, which I denominate the metallic shank, which laps over the rear end of the outsole, and is continued back in one piece, so as to form a portion of the heel."

"What I claim as constituting my invention, and desire to secure by letters patent, is the employment of a metallic shank, extending along the instep and heel of boots and shoes, in place of the outsoles of leather, said shank being formed and affixed substantially in the manner set forth."

39. For a method of *Increasing the Draught of Chimneys;* Joseph Hurd, Jr., Stoneham, Middlesex county, Massachusetts, April 24.

Through the horizontal part of such a cowl as is usually employed on chimney tops, and which is provided with a vane to give it a proper direction, a horizontal shaft passes, which has a wheel on each end, that at the open end of the cowl being provided with radial vanes, parallel with the axis of the wheel, so that by its centrifugal action on the air, it tends to generate a vacuum in the chimney, and thus form a draught; and that on the closed side is provided with inclined vanes, against which the wind acts, and by which the whole is operated, or put in motion.

Claim.—"I shall claim discharging the smoke from a chimney, or the impure air of an apartment from the same, by a discharging wheel, constructed and revolved as described, and also by means of a cowl having a horizontal shaft passing through it, upon the front end of which a wind wheel is affixed, and upon the rear end, and over the mouth of the cowl, a discharging wheel, to be set in motion by the action of the wind on the former, the proper position of said cowl, with respect to the wind, being regulated by a vane suitably attached to, and which turns, the same, the whole being arranged and operating substantially as set forth."

There are several different cowls, or chimney caps, which operate to advantage when there is a good breeze of wind, but we do not know of one which is effective at any other time; they tend, in many instances, rather to obstruct than to aid the draught when the atmosphere is still; this, we apprehend, is unavoidable.

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40. For an improvement in *Iron Bridges;* Squire Whipple, Utica, Oneida county, New York, April 24.

The claim under this patent gives a sufficiently clear description of the nature of the improvement, and is as follows:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of sustaining the flooring of bridges by iron trusses containing cast-iron arches, formed in sections, or segments, in combination with diagonal ties, or braces, to sustain the form of the arch against the effect of unequal pressure, (with or without vertical posts, or rods,) and wrought-iron arch strings, or thrust ties, to sustain the thrust and prevent the spreading of the arch, in case the abutments and piers be not relied on for that purpose. Also, the divergence, or horizontal expansion, of the arch, from the middle portion to the ends thereof, in wooden trusses, or arches, as well as in those composed of iron."

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41. For an improvement in the *Window Fastener;* James P. McKean, Washington, District of Columbia, April 24.

The family of window fasteners is a very large one, not fewer than forty patents having been obtained for devices for this purpose; it would be no easy task, therefore, to compare a new comer with its

forerunners; this, therefore, we shall not attempt, nor shall we describe the features of that before us any further than they are given in the following:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the bolt working through the lower rail of the shutter, near one edge, with the bar, or lever, having a handle (passing through to the inside of a shutter) near the other edge, for the purpose, and in the manner, described."

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42. For an improvement in the *Smut Machine,* for clearing grain from smut, garlic, &c.; James Coppuck, Mount Holly, Burlington county, New Jersey, April 24.

The outer case of this machine consists of a truncated cone, with the inside fluted, or channeled. The flutes, or channels, are made by alternate staves of about three inches at the greater diameter of the truncated cone, and gradually diminishing, and about an inch and a half deep at top, and gradually diminishing to nothing. A curved dish, with a hole in the centre, and a bridge tree, for the support of the spindle of the fan, is attached at the bottom, or small end, of the cone. A conical fan, with a cap, revolves within this case, the cap being equal, in diameter, to the larger inner diameter of the case; and the whole is covered with a semi-spherical cap, which is provided with a flue for every flute, or channel, in the case, through which the grain is fed. The current of air which moves from the smaller and towards the larger, meets the grain as it descends in the flues, and this, together with the action of the fans and flutes, or channels, separates the dirt, &c., from the grain.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of constructing the cylinder, or truncated cone, with flutes, as described, in combination with the revolving fan, or wings, acting as beaters, and to produce a current of air through the machine, the whole being constructed and operating substantially in the manner set forth."

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43. For an improvement in the *Winnowing Machine;* Zalman Rice, Lyons, Wayne county, New York, April 24.

In addition to the common blower, or fan wheel, of the well-known wheat fan, there is, in this machine, a second fan wheel, which throws a current of air downwards on an additional screen, or sieve, which at the same time receives a current of air from below, from the common fan wheel; below this sieve, or screen, two or more screens may be added at pleasure. "The screen is covered with wire that will admit the grain to fall freely through it upon a second sieve, or screen; as the upper sieve receives the wind directly on its upper surface, from the small fan wheel, the smut balls, white caps, and other matters which are larger than the grain, are thereby effectually blown off from it. Excepting towards its front edge, the lower side of the screen is defended from the action of the wind from the large fan

wheel, by a piece of thin wood, a sheet of metal, or other suitable substance, fastened on to the lower side of its frame, and extending from the back to within a few inches of the front of it. This piece I call a conductor, as it carries, or conducts, the whole of the grain to the opening through which it passes, and falls upon the screen below it."

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner of employing a second fan wheel, operating in a direction the reverse of that usually employed, so as that the current of wind from it shall be directed downwards in the manner, and for the purpose, set forth. I also claim the using of the device which I have denominated a conductor, on the lower side of the upper screen, and attached to the frame thereof, and also, if preferred, on the lower sides of the frames of the sieves, or screens, used for sifting, or screening, in such a machine as herein described and made known; said conductors being so placed as to adapt them to the carrying of the grain, or other matters, either backwards or forwards, according to the directions required by the inclinations given to such screens, or sieves."

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44. For an improvement in the *Saw Gin, for Ginning Cotton;* C. A. McPhetridge, Natchez, Adams county, Mississippi, April 24.

Instead of the grate bars in the ordinary saw gin, between which the saws pass, and draw the cotton, to separate the fibre from the seeds, they, in this machine, pass in grooves made for that purpose in a roller placed above the saw cylinder.

Claim.—"What I claim as my invention, and which I wish to secure by letters patent, is the peculiar arrangement of the roller, having grooves into which the saws work, in combination with the saws, for the purpose, and in the manner, described."

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45. For an improvement in the apparatus for *Destroying Canker Worms;* Daniel Newhall, Lynn, Essex county, Massachusetts, April 24.

This patent is for an improvement added to the patent granted on the 31st day of October, 1840, and noticed in this Journal, vol. ii, 3rd series, page 406.

For the purpose of preventing the oil, or other liquid, used in the trough for destroying the worm, from overflowing, in consequence of the percolation of water into it, there is to be an inclined pipe, the lower end of which reaches to the bottom of the trough, and the upper end within a short distance of the height of its edge. Sufficient water is first put into the trough to cover the end of the pipe, and the oil, or other fluid, is then poured in. When rain falls, and passes into the trough, the superabundant water will flow over at the upper end of the inclined pipe, and the oil thus be preserved from escaping.

Claim.—"Having thus described my improvement, I shall claim, as my invention, a pipe, or tube, arranged substantially as described, in combination with the trough, for the purpose of preventing the oil,

or destroying liquid, from being displaced, or forced out of the trough."

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46. For improvements in the *Cooking Stove;* Hiram Blanchard, Aquackamonk, Passaic county, New Jersey, April 27.

The improvements that constitute the subject of this patent, is in that kind of cooking stoves that have the oven back of the fire chamber, and an air chamber between the two. The guard plate which forms the false back of the fire chamber has a "cross piece," or flanch, projecting from it, that forms the bottom of the air chamber. The upper part of this guard plate is bent back to form the top of the air chamber, and its lower part bent forward to prevent coals and ashes from passing into the flue, under the oven. The upper part of the fire chamber is inclined forward, and provided with apertures and a register to carry off the smoke, &c., when articles are cooked on the hearth.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is, 1st. Constructing the guard plate with a cross piece to form the bottom of the air chamber, in combination with the vertical shield, or continuation of the guard plate, extended below said cross piece, for the purpose of preventing coals, &c., passing into the flue under the oven, the whole being constructed as before described. 2nd. Constructing the front of the stove with an inclination forward and above the hearth of said stove, in combination with the apertures governed by a register, as set forth, for the purpose of receiving the smoke, &c., when articles are cooked on the front hearth, or ashes, when the fire is raked, as described."

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47. For an improvement in *Piston Rods of Steam Engines;* John R. St. John, Cleveland, Cuyohoga county, Ohio, April 27.

The rod of the piston, which works in the cylinder, as described in the specification of this patent, is hollow, its outer end being attached to a slide, and in it there is a small hollow piston, to the rod of which the connecting rod, from the crank, is jointed. Two such must be employed, with two cranks placed at right angles. By this arrangement, a crank of greater capacity than the length of the cylinder may be employed. As a modification of this arrangement, the patentee proposes the connecting of the slide of the piston rod, by means of a toggle joint, with the slide to which the connecting rod is jointed.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of two or more compound piston rods working in appropriate cylinders, as set forth, with an equal number of cranks arranged on the shaft, to which the power is communicated, the whole being combined, constructed, and operating substantially in the manner, and for the purpose, described. The said compound piston rod being my own invention, but not claimed for reason of being effective only in a combination of two or more, as claimed and set forth."

Specifications of American Patents.

Specification of a patent granted to John D. Prince, *Lowell, Massachusetts, on the 24th of April,* 1841, *for a new mode of producing a Black Color in Dyeing.*

To all whom it may concern: Be it known that I, John D. Prince, Jr., of Lowell, in the state of Massachusetts, have invented, or discovered, a new and improved mode of producing a black color, in the operation of dyeing, by a combination of ingredients not heretofore employed in the manner, and for the purpose, discovered and adopted by me. The common mordant used in dyeing various articles of a black color is, as is well known, an acetate of iron; and the best effect of this mordant is obtained when, by the action of the air, a mixture, or compound, of the protoxide of iron is formed on the substance to be dyed. I have ascertained, by repeated trials, that the proto-sulphate of iron (copperas) may be advantageously substituted for the acetate of iron, as a mordant, by bringing it into that state which shall coerce it to deposite these two ingredients, the protoxide and peroxide of iron, on the goods under treatment. There are various articles which effect this purpose to a certain extent, but that which I found to do so in the most perfect manner, is the arsenious acid (arsenic) mixed, or combined, with the proto-sulphate. The proportions of the two ingredients admit of considerable latitude, but the following has been found to answer well. I dissolve one pound of copper in a gallon of water. and in another gallon of water I dissolve four ounces of white arsenic, and then mix the two solutions, which mixture constitutes my iron liquor. For the purpose of transportation it is desirable to obtain the ingredients from which the solution is to be made, in a dry state; for this purpose I take copperas and drive off its water of crystalization by exposing it to heat upon iron, or in any other convenient mode, and to the dried mass I add four ounces of white arsenic for every pound of copperas first taken, the whole is then reduced to powder, and may be readily converted into iron liquor by adding the proper quantity of water. The tendency of the protoxide, in copperas, is to pass too rapidly and completely into the state of peroxide, by which the object of obtaining a good black color is defeated, an injurious brown tint being produced. The arsenious acid has the property of preventing the peroxidation, and of inducing that state of mixed oxide upon which the perfection of the black is dependant, and this combination of arsenious acid, and its application to the purpose of producing a black color are, as I believe, entirely new. Having thus fully described the nature of my invention, what I claim therein, and desire to secure by letters patent, is the combining of arsenious acid with sulphate of iron, in the manner, and for the purpose, herein fully made known; and this I claim whether the two substances are mixed in a dry state, and afterwards dissolved, or whether the two substances be separately dissolved, and afterwards mixed together. Nor do I intend to limit myself to the proportionate quantities of the two substances herein stated as being generally used, but intend to vary these proportions within any limits which I may find to be advantageous." John D. Prince.

Co

									Hygrometer.					
	Minimum. S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point	Wet Bulb.	Days omitted.	No. of Report.
1	.34⅔	⅓	5⅓	1⅓	5⅔	⅓	.	1⅔	....	.	.....	....	.	1793
2														
3	.26	⅔	2⅓	2	8⅓	⅓	.	2⅓	....	.	.....	....	.	1719
4														
5														
6	.9 ⅓	.	6	.	3	.	.	12⅔	....	.	.....	....	.	1694
7														
8														
9	.21⅔	.	8⅓	.	9⅔	.	.	.	....	.	.....	....	.	1733
10														
11	.61	.	3½	.	6⅓	.	12⅓	2⅓	....	.	.....	....	.	1668
12														
13	.7 ⅓	.	14⅔	.	⅓	.	.	5	....	.	.....	....	.	1682
14	.71⅔	1	6⅓	2⅓	5⅔	1⅓	⅔	2⅔	....	.	.....	....	.	1681
15	.72⅓	1⅓	5⅓	2⅔	1⅓	2⅓	.	⅓	31.21	1	.....	36.47	1	1742
16														
17														
18	.1[illegible]	.	3⅔	.	15⅓	.	.	.	....	.	.....	....	.	1660
19	.71	.	7	.	3⅔	.	3⅓	.	....	.	.....	....	.	1659
20														
21														
22														
23														
24														
25														
26	.38 ⅓	.	3	.	8⅓	.	14⅔	1⅔	....	.	.....	....	.	1691
27														
28	.78	⅔	2⅓	1⅓	5	.	8⅓	⅔	....	.	.....	....	.	1662
29	.72⅔	⅔	4	⅔	3⅓	⅔	4⅔	1⅓	31.57	20	.....	39.13	20	1747
30														
31	.70	.	23⅓	.	.	.	.	1⅓	....	.	.....	....	.	1685
32	.524⅓	.	3⅔	.	11	.	.	⅔	....	.	.....	....	.	1664
33														
34														
35														
36	.123⅓	.	12⅔	.	3⅔	.	⅔	2⅔	....	.	.....	....	.	1684
37	.577	.	3⅔	.	8	4	.	⅔	....	.	.....	....	.	1661
38	.192⅓	2	7	⅔	2⅓	.	7	5⅓	....	.	...	29.96	7	1701
39														
40														
41														
42	.238⅔	.	.	.	17	.	.	.	....	.	.....	....	.	1683
43														
44														
45														
46														
47														
48	.57 ⅓	.	1⅓	2⅓	6⅓	.	9⅓	1⅔	....	.	.....	....	.	1665
49														
50	.101⅔	.	6	.	3⅔	.	.	.	....	.	.....	....	.	1663
51														
52	.034	.	5	.	2	.	6½	2⅓	....	.	.....	....	.	1666
53														

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
DECEMBER, 1841.

County.	Town.	Observer.
1 Philadelphia	Philadelphia	E. W. Hamilton
2 Montgomery		
3 Bucks	Newtown	L. H. Parsons
4 Lehigh		
5 Northampton		
6 Monroe	Stroudsburgh	A. M. Stokes
7 Pike		
8 Wayne		
9 Susquehanna	Silver Lake	E. Rose
10 Luzerne		
11 Schuylkill	Port Carbon	P. Carbon Lyceum
12 Berks		
13 Chester	West Chester	E. W. Bean
14 Delaware	Haverford	Haverford School
15 Lancaster	Lancaster	Conservatory of Arts
16 York		
17 Lebanon		
18 Dauphin	Harrisburg	J. Heisely
19 Northumberland	Northumberland	Andrew C. Houston
20 Columbia		
21 Bradford		
22 Tioga		
23 Lycoming		
24 Union		
25 Mifflin		
26 Juniata	Mifflintown	J. A. Kinkaid
27 Perry		
28 Cumberland	Carlisle	Prof. W. H. Allen
29 Adams	Gettysburg	Prof. M. Jacobs
30 Franklin		
31 Huntingdon	Huntingdon	Prof. Jacob Miller
32 Centre	Bellefonte	John Livingston
33 Potter		
34 M'Kean		
35 Clearfield		
36 Cambria	Ebensburgh	Richard Lewis
37 Bedford	Bedford	Samuel Brown
38 Somerset	Somerset	George Mowry
39 Indiana		
40 Jefferson	Punxsutawny	J. Smith
41 Warren		
42 Venango	Franklin	Wm. Connely
43 Armstrong		
44 Westmoreland		
45 Fayette		
46 Green		
47 Washington		
48 Allegheny	Pittsburgh	J. P. Bakewell
49 Beaver		
50 Butler	Butler	Jacob Mechling
51 Mercer		
52 Crawford	Meadville	Henry Shippen
53 Erie		

Thermometer.

County	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
Philadelphia	32.55	46.33	37.87	74.00	15.00	38.92	⅔	10.00	27.47	1
Bucks	28.51	37.41	32.51	52.00	10.00	32.81	⅓	7.50	27.27	2
Monroe	25.33	34.48	22.70	49.00	7.00	27.50	13⅓	......	......	..
Susquehanna	17.42	24.10	20.10	57.00	-2.00	20.54	.	-2.00	15.55	..
Schuylkill	26.50	39.20	30.30	49.00	3.00	32.00	2⅓	1.00	22.87	1
Chester	28.90	40.33	33.42	52.00	11.00	34.22	⅓	......	......	..
Delaware	31.55	37.41	34.26	52.00	14.00	34.41	⅔	8.00	26.67	2
Lancaster	27.79	39.10	33.74	54.00	10.50	34.21	⅓	10.50	28.13	..
Dauphin	31.90	35.81	34.84	50.00	16.00	34.18	.	13.00	27.10	..
Northumberland	28.90	35.58	32.13	48.00	4.00	32.20	.	2.00	25.39	..
Juniata	28.08	37.42	31.40	50.00	3.00	32.30	2⅓	......	......	..
Cumberland	26.67	36.97	31.13	53.00	7.00	31.59	⅔	7.00	25.77	..
Adams	26.89	37.44	31.88	52.00	11.00	32.07	1	9.50	25.87	1
Huntingdon	27.32	36.89	32.58	52.00	2.00	32.26	1⅓	......	......	..
Centre	30.19	35.73	31.10	47.00	4.00	32.34	⅓	......	......	..
Cambria	24.07	31.04	26.27	51.00	3.00	27.13	2⅔	3.00	23.03	1
Bedford	27.86	36.47	31.96	56.00	11.50	32.10	⅓	......	......	..
Somerset	28.44	32.67	29.88	51.00	14.00	30.33	5⅔	6.50	22.78	3
Venango	34.84	42.13	40.48	56.00	18.00	39.15	.	......	......	..
Allegheny	38.00	40.85	40.03	49.00	29.00	39.63	1⅔	12.00	28.94	..
Butler	32.00	37.10	34.90	59.00	12.00	34.67	.	......	......	..
Crawford	28.57	34.90	29.60	52.00	6.00	31.02	⅔	5.00	25.83	1

Barometer. — Weather.

County	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
Philadelphia	30.05	30.02	30.03	30.75	29.33	30.03	1	21⅔	8⅓	1	10	2	1	..	5.441
Bucks	29.91	29.91	29.92	30.60	29.24	29.91	⅓	9	21⅔	⅓	7	2	......	..	6.625
Monroe	29.58	29.64	29.61	30.15	28.95	29.61	12⅓	7⅔	11⅓	12	5	3	1	..	5.95[illegible]
Susquehanna	27.77	27.79	27.79	28.21	27.25	27.78	.	3⅔	27⅓	.	2	7	......	..	2.433
Schuylkill	29.19	29.21	29.22	29.61	28.66	29.21	2⅓	9⅔	18⅓	3	5	5	2	..	4.893
Chester	29.44	29.43	29.44	30.07	28.78	29.44	⅓	12	13⅓	5⅔	9	2	1	..	4.840
Delaware	29.41	29.37	29.33	30.15	28.75	29.37	4⅓	10	16⅓	4⅔	6	1	......	..	6.[illegible]09
Lancaster	29.45	29.41	29.45	30.07	28.78	29.44	⅓	11	19⅔	⅓	4	1	3	..	3.295
Dauphin	29.73	29.71	29.72	30.38	29.13	29.72	.	.	.	.	......	......	......	..	......
Northumberland	29.38	29.40	29.39	30.01	28.70	29.39	.	5⅓	25⅔	.	7	4	......	..	5.509
Juniata	29.49	29.44	29.45	30.07	28.38	29.46	2	5⅔	22⅔	2⅔	......	......	......	..	......
Cumberland	29.33	29.30	29.32	29.93	28.78	29.32	⅔	6⅔	23⅔	⅔	4	1	2	..	5.690
Adams	29.32	29.31	29.31	29.91	28.75	29.31	1	8⅓	21⅔	1	9	2	......	..	6.060
Huntingdon	29.31	29.29	29.30	29.90	28.70	29.30	1⅓	8	23	.	8	2	2	..	3.593
Centre	29.20	29.18	29.16	29.80	29.52	29.18	⅓	5	25⅔	⅓	7	3	1	..	4.410
Cambria	27.70	27.71	27.71	28.14	27.12	27.71	2⅔	⅓	26⅓	4⅓	4	4	1	..	2.128
Bedford	29.13	29.14	29.14	29.70	28.57	29.14	⅓	7	23⅔	⅓	......	......	......	..	......
Somerset	27.67	27.68	27.71	28.15	27.19	27.69	5⅓	3⅓	22	5⅔	4	1	7	..	3.664
Venango	28.95	28.92	28.95	29.80	28.23	28.94	.	.	.	.	7	4	......	..	3.798
Allegheny	29.09	29.06	29.10	29.65	28.57	29.08	1⅔	4	25⅓	1⅔	9	2	2	..	3.744
Butler	28.68	28.71	28.72	29.20	28.10	28.70	.	.	.	.	5	7	1	..	3.985
Crawford	28.65	28.68	28.65	29.27	28.03	28.66	⅔	2	27⅓	1⅔	6	4	3	..	4.125

Winds.

County	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
Philadelphia	4	½	3⅔	.	1	.	1½	.	1	⅓	1⅔	⅓	5⅓	1½	5⅔	⅓	.	1⅔
Bucks	⅔	1½	4⅓	.	⅔	.	1⅔	.	.	.	5	⅔	2⅓	2	5½	.	.	2⅓
Monroe	2	.	2	.	4	.	1	.	.	.	½	.	6	.	3	.	.	12⅔
Susquehanna	9⅓	.	.	.	.	.	2	.	.	.	1⅔	.	8⅓	.	9⅔	.	.	.
Schuylkill	1	.	2½	.	1⅔	.	⅔	.	.	.	1	.	3⅓	.	6⅓	.	12⅓	2⅔
Chester	1⅔	.	1	.	1⅓	.	.	.	6½	.	⅓	.	14⅔	.	⅓	.	.	5
Delaware	3	1	3	⅔	1	.	.	.	.	⅔	1⅔	1	6⅓	2½	5⅓	1½	⅓	2⅔
Lancaster	3	1⅓	2⅓	⅔	1	⅓	1	1	2	2	4⅓	1½	5⅓	2⅔	1⅓	2⅓	.	⅓
Dauphin	⅔	.	2⅔	.	2⅔	.	6	.	.	.	.	.	3⅔	.	15⅓	.	.	.
Northumberland	4⅔	.	4⅔	.	3½	.	⅔	.	2⅔	.	1	.	7	.	3⅔	.	3½	.
Juniata	⅓	.	1⅔	.	⅓	.	⅔	.	.	.	⅓	.	3	.	8⅓	.	14⅔	1⅔
Cumberland	2⅔	.	4⅔	.	⅔	.	⅓	⅓	⅔	⅓	3	⅔	2⅓	1⅓	5	.	8⅓	⅔
Adams	3	1⅓	2	.	.	.	⅔	1	4⅓	⅔	⅔	⅔	4	⅔	3⅓	⅔	4⅔	1⅓
Huntingdon	.	.	.	.	6⅓	.	.	.	.	.	.	.	23⅓	.	.	.	.	1½
Centre	5⅓	.	2⅔	.	.	.	2	.	1⅓	.	4⅓	.	3⅔	.	11	.	.	⅔
Cambria	2	.	⅔	.	.	.	4	.	1⅓	.	3⅓	.	12⅔	.	3⅔	.	⅔	2⅔
Bedford	.	.	.	.	⅔	.	5⅔	.	.	1⅓	[illegible]	.	3⅔	.	8	4	.	⅔
Somerset	.	.	.	.	⅓	.	2⅓	.	1⅔	.	2⅓	2	7	⅔	2⅓	.	7	5⅓
Venango	.	.	.	.	.	.	5⅓	.	.	.	8⅔	.	.	.	17	.	.	.
Allegheny	.	.	3⅓	1⅓	⅔	⅔	3⅓	.	.	.	⅓	.	1⅓	2⅓	6⅓	.	9⅓	1⅔
Butler	.	.	1	.	7⅓	.	1	.	⅓	.	11⅔	.	6	.	3⅔	.	.	.
Crawford	3	.	.	.	1	.	1⅓	.	6	.	4	.	5	.	2	.	6⅓	2⅓

Hygrometer.

County	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
Philadelphia	....	.	.....	....		179[illegible]
Bucks	....	.	.....	....	.	1719
Monroe	....	.	.....	....	.	1694
Susquehanna	....	.	.....	....	.	17[illegible]
Schuylkill	....	.	.....	....	.	15[illegible]
Chester	....	.	.....	....	.	1692
Delaware	....	.	.....	....	.	1691
Lancaster	31.21	1	.....	35.47	1	1742
Dauphin	....	.	.....	....	.	1560
Northumberland	....	.	.....	....	.	1559
Juniata	....	.	.....	....	.	1651
Cumberland	....	.	.....	....	.	1562
Adams	31.57	20	.....	39.13	20	1747
Huntingdon	....	.	.....	....	.	1655
Centre	....	.	.....	....	.	1564
Cambria	....	.	.....	....	.	1654
Bedford	....	.	.....	....	.	1652
Somerset	....	.	.....	29.96	7	1721
Venango	....	.	.....	....	.	1582
Allegheny	....	.	.....	....	.	1665
Butler	....	.	.....	....	.	1662
Crawford	....	.	.....	....	.	1666

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